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NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

MATERIAL LOGISTIC SUPPORT
OF
THE HOSPITAL SHIPS

by

Thomas A. Ebert
and
Donald W. Hess

December 1986

Thesis Advisor:

Thomas P. Moore

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Material Logistic Support
of
the Hospital Ships

by

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December 1986

ABSTRACT

The *USNS Mercy* will shortly be accepted by the U.S. Navy. While the conversion of an oil tanker into a first class floating hospital has received the appropriate attention, the logistical support of the *Mercy* has not. This thesis looks at the provisioning and resupply of the *Mercy* with the objective of identifying a method of stratifying medical stores by an Essentiality Index. What is presented is a logical and reliable means to rank medical consumables by the degree of cure provided to a projected patient stream.

This thesis recommends that an Essentiality Index be calculated for all medical consumables projected by the Combat Zone Assessment Requirements and Sets, Kits and Outfits models. Utilization of this Essentiality Index will positively impact the provisioning of the *USNS Mercy*, improve the range and depth of medical consumables listed in the Fleet Issue Load List, and, in general provide a tool to better manage medical consumables throughout the supply system.

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I. INTRODUCTION

A. BACKGROUND

Great Britain learned from the Falklands experience that the hospital ship has a proven place in modern warfare. However, the British encountered many difficulties before they were able to successfully convert, in sixty-five hours, the *SS Uganda* from an education cruise liner to a one thousand bed hospital ship. The *SS Uganda* had no flight deck, no stations for replenishment at sea, inadequate power and lighting and was incapable of producing water. The British concluded from this conversion experience that there exists a need to have a dedicated hospital ship. [Ref. 1: p. 16]

Fifteen years have passed since the United States has had a dedicated hospital ship. This ship, the *USS Sanctuary*, was originally commissioned on 20 June 1945. It served briefly in the closing months of World War II and was transferred to the Maritime Administration in the early 1950's. On 15 November 1966 it was reactivated and saw service off Vietnam. The *Sanctuary* was decommissioned as a hospital ship on 15 December 1971 and recommissioned on 18 November 1972 as a support ship for military dependents stationed in Greece. [Ref. 2: p. 429]

In December 1986, the United States Navy will have, once again, a dedicated hospital ship, the *USNS Mercy*. It is so advanced and so large that few land based hospitals can surpass its facilities. In May 1987, a second hospital ship - *USNS Comfort* will be delivered to the Navy. Each ship is converted from a San Clemente class tanker, and contains eighty Intensive Care beds, twelve operating rooms, four x-ray rooms, a computer axial tomography (CAT) scanner, two laboratories and a pharmacy. Figures 1.1 to 1.7 [Ref. 3] show the *USNS Mercy* and its deck layouts. Table 1 portrays a comparison between the *USS Sanctuary* [Ref. 2: p. 429] and *USNS Mercy* [Ref. 3].

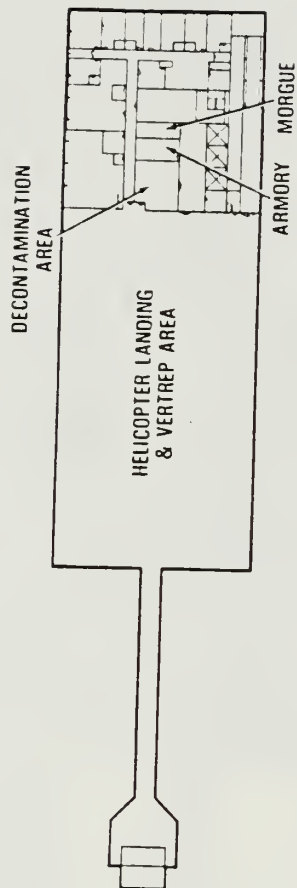
The ship is much larger than any previously known hospital ship, and is bigger than any ship in the United States Fleet except an aircraft carrier. The size and purpose of this hospital ship present major maintainability and supportability challenges for the Navy Supply Corps and Medical Service Corps.

The difference between the *Sanctuary* and *Mercy* are not just limited to size. The *Mercy* is designated as United States Naval Ship (USNS) vice USS and thus will be



Figure 1.1 USNS Mercy.

03 LEVEL



02 LEVEL

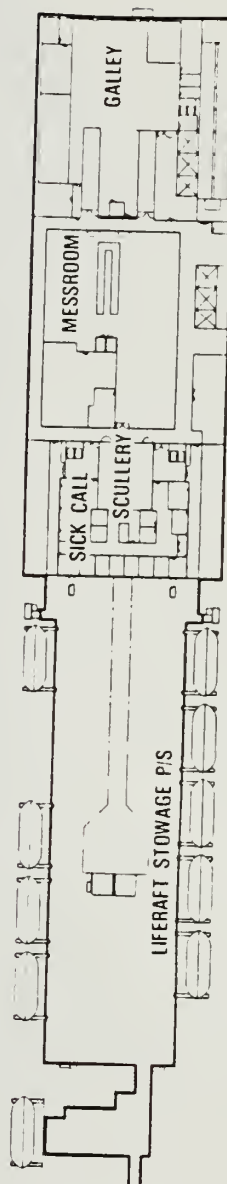
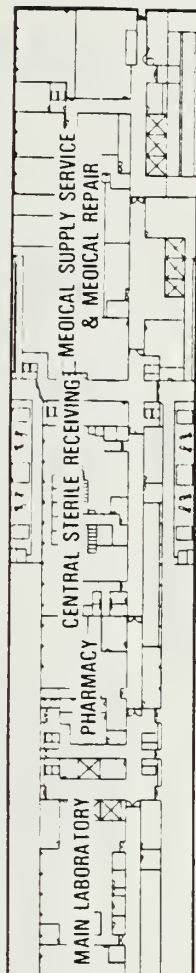


Figure 1.2 Deck Arrangements.

01 LEVEL



MAIN DECK

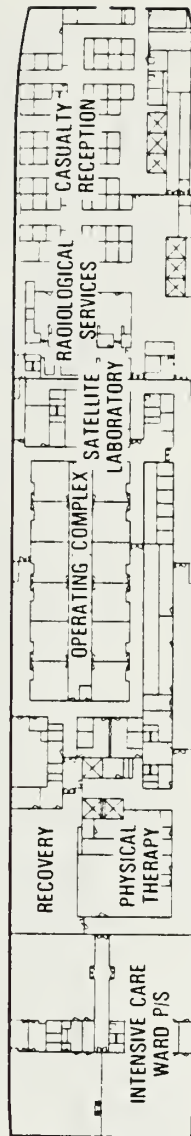
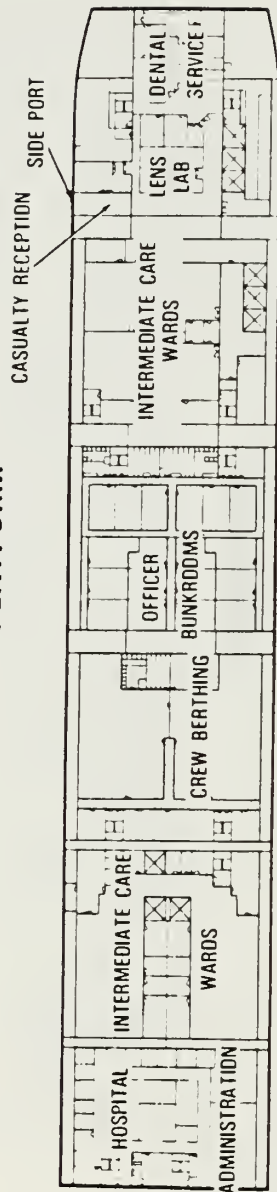


Figure 1.3 Deck Arrangements.

1ST PLATFORM



2ND PLATFORM

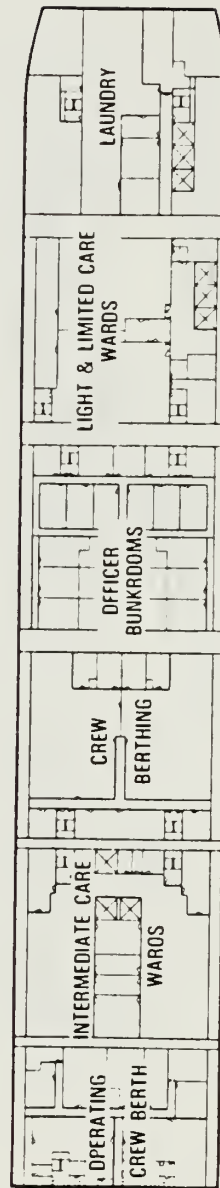
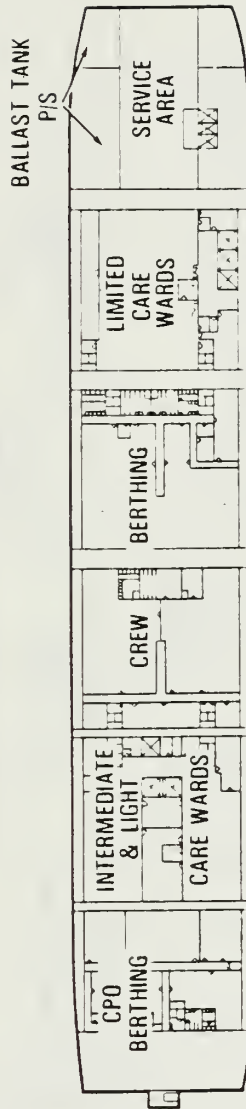


Figure 1.4 Deck Arrangements.

3RD PLATFORM



4TH PLATFORM

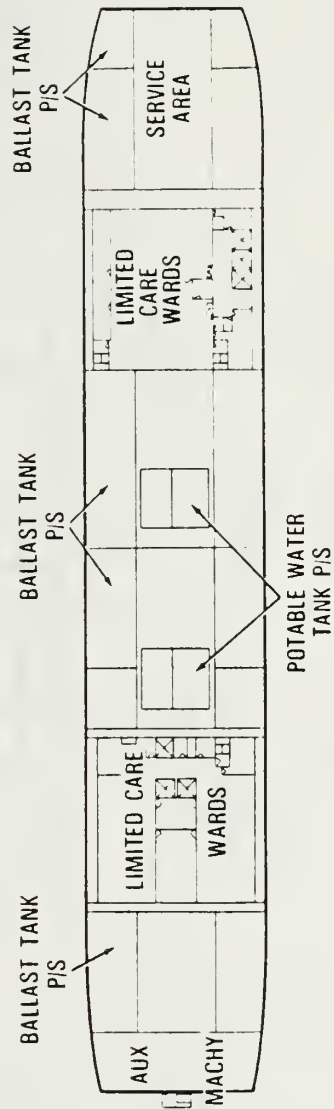


Figure 1.5 Deck Arrangements.

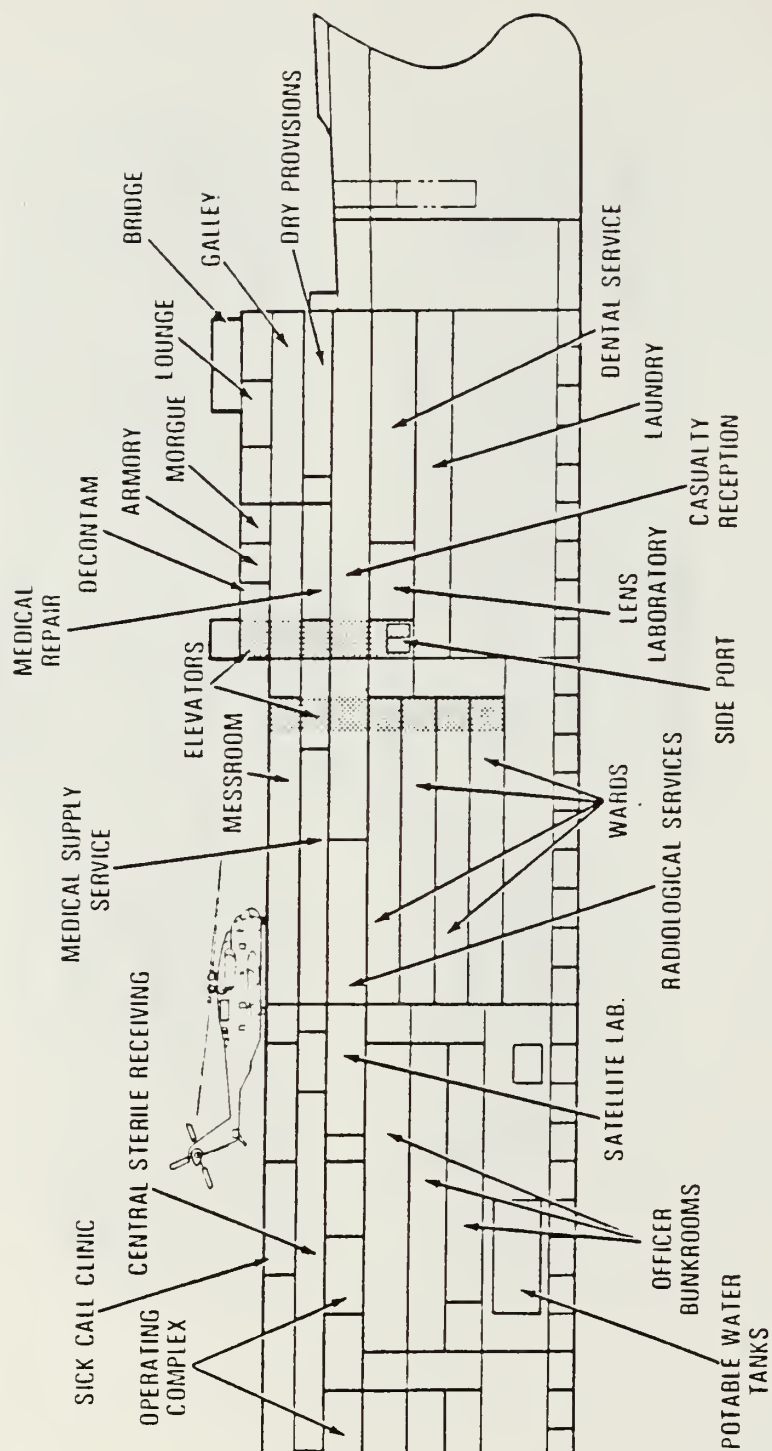


Figure 1.6 Bow Inboard Profile.

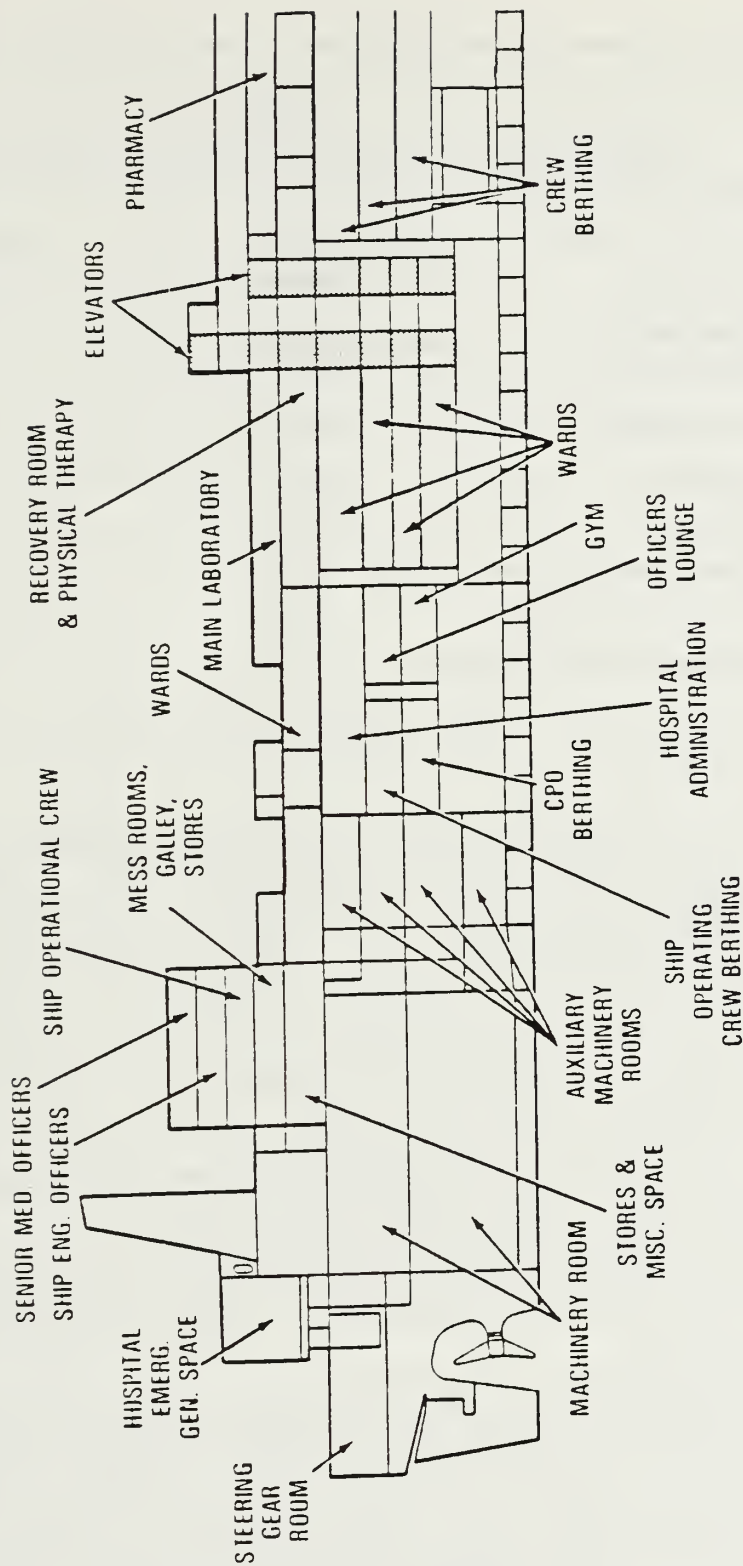


Figure 1.7 Stern Inboard Profile.

TABLE 1
COMPARISON OF USS SANCTUARY AND USNS MERCY

	<i>USS Sanctuary</i>	<i>USNS Mercy</i>
Length(Feet)	496	894
Width(Feet)	72	105
Medical Crew	323	817
Physicians	24	55
Dentists	3	6
Nurses	29	174
Administrators	9	20
Hospital Corpsmen	258	562
Operating Capacity(Beds)	750	1000

assigned to the Military Sealift Command (MSC) instead of the U. S. Navy. A determining factor in whether to designate the *Mercy* as USS or USNS was the congressionally imposed limit on the Navy's manning level. This level was not considered sufficient to provide crews for ships under construction or planned, including the hospital ships. Therefore, the *Mercy* will be operated by a non-military crew. It has not been decided if the operating crew will be a civilian contractor or civilian employees of MSC. That will be decided by the contracting out policies specified in the Office of Management and Budget (OMB) Circular A-76. Unlike the *Sanctuary*, the *Mercy*, during peacetime, is destined to be tied to a pier. The U. S. Navy plans to place the vessel in Reduced Operating Status Five (ROS-5), i.e., capable of being activated to Full Operational Status (FOS) and underway in no more than five days time. [Ref. 3]

Although the Military Sealift Command will have operational control of the *Mercy*, actual operation of the ship, except the medical treatment facility, will be performed by the civilian crew. This includes the maintenance of the propulsion, auxiliary and non-medical electronics systems, engineering, seamanship, navigation and communication. While in ROS-5, the civilian crew and a skeleton military crew will

maintain the ship. When the *Mercy* is activated to support combat operations, the military crew will augment the civilian crew during replenishment and helicopter refueling operations and in damage control. The embarked military crew would also provide standard postal, ship's store, barber shop, laundry and food services. Equipment belonging to the medical treatment facility and the liquid oxygen generating plant will be maintained by medical personnel.

Within the five day activation period, approximately 1100 military personnel (820 medical and 240 non medical) would have to be brought aboard. The personnel will come from billets controlled by Naval Medical Command throughout the continental United States and will include Medical, Supply, Engineering, Deck and Administrative group ratings. In addition, provisions to feed nearly seven thousand meals a day for twenty to thirty days, and to top off medical supplies and repair parts will have to be brought on board and stored.

These two hospital ships represent a major system acquisition as defined in Office of Management and Budget (OMB) Circular A-109 dated 5 April 1976 and implemented by Department of Defense Directive 5000.1 dated 29 March 1982. A major system is a combination of elements that will function together to produce the capabilities required to fulfill a mission need. [Ref. 4: p. 4] It is the policy of the Department of Defense that integrated logistic support (ILS) planning of major systems take place early in the formulation of the acquisition process to ensure that the new system will be able to achieve the objective for which it was planned at an affordable operating cost. [Ref. 5: p. 7] Operating cost refers to those costs that are incurred after the system is delivered. In ILS planning, a cost-effective balance must be sought among acquisition costs, operating costs and measures of system effectiveness. One major element of integrated logistic support is supply support. This element makes a significant contribution towards the maximization of operational readiness by bringing together the right amount of material at the right time and right place at an affordable operating cost.

While the capabilities of *Mercy* are readily identified, the actual peacetime use of the ship has not been determined. While in ROS-5, *Mercy* will remain pierside at her tentative homeport of Oakland, California. The ship will put to sea for seven to fourteen days each year for operational testing of her engineering systems. The question of whether to restrict the *Mercy* to her primary mission of providing acute medical care in support of amphibious task forces, or to authorize her to aid

international relief following natural disasters, has not been resolved. In either case, sufficient supplies of medical stores with the proper mix of items to support the anticipated casualty load must be available for delivery to and loading aboard *Mercy*.

B. PROBLEM DEFINITION AND OBJECTIVE

In January 1986, a logistic review group from the Office of the Chief of Naval Operations (OPNAV) identified a number of deficiencies in the integrated logistic support planning for the hospital ships. Two key findings were that a plan for rotation of dated and deteriorated medical items had not been developed, and that an adequate method for resupplying medical consumables while deployed had not been found. [Ref. 6]

As originally configured during conversion, *Mercy* had storage facilities for immediate use medical consumables. An oversight during the design of the ship resulted in a storage space requirement being computed based upon interior packaging dimensions. Unfortunately, medical supplies must be stored in their larger industrial packaging. Subsequent correction of this error resulted in the addition of a storeroom with 26,600 cubic feet on the 03 level of the ship. This storeroom, plus existing spaces, provides storage capacity for an estimated fifteen day supply of medical material. This is considerably less than the thirty day endurance which United States Navy combatants are required to have on board. This limitation will require special resupply considerations and must be analyzed as to its affect upon other components of the supply system, such as the support cargo ships.

Hospital ships are accorded special protection as non-combatants under the Geneva Conventions. However, this special protection can be obtained only if the ship does not perform a hostile act, such as sending or receiving coded messages. Even though the hospital ship has the capability to handle two helicopters at a time, there is no plan to have a medical helicopter detachment permanently assigned. In that respect, any helicopters used for underway vertical replenishment, other than those properly identified and operated as medical aircraft, will not be protected under the Geneva Conventions. [Ref. 7: p. 84] Therefore, these helicopters are subject to attack even when in close proximity of the *Mercy*. This can endanger the *Mercy* by exposing it to hostile fire.

Also, due to the size of the *Mercy*, she cannot be berthed in many of the world's harbors. This also complicates resupply and patient transfer, because standard material handling equipment available at dockside cannot be used.

Medical consumables are routinely managed, i.e., issued and rotated, based on the shelf life of the item. Shelf life is the time span during which an item is considered safe and potent for use. Upon reaching the end of shelf life, medical consumables are either disposed of or their shelf life is extended, if inspection by competent authority determines this is safe. The Inspector General, Department of Defense indicated that of the approximately fifteen million dollars of prepositioned war reserve stocks owned by the Marine Corps in the Pacific Theatre, two million dollars were destroyed in fiscal year 1985 as a result of expired shelf life [Ref. 8: p. 58]. While the information is not readily available to determine the dollar value which is lost to the Department of Defense or the Navy as a result of disposed medical stores because of expired shelf life, this problem will increase rapidly over the next few years as more deployable medical systems come on line and are prepositioned around the world.

From the material logistics support perspective, shelf life considerations, storage limitations and Geneva Convention problems create two questions for the hospital ships. First, what alternative prepositioning plans for dated and deteriorated medical consumables should be considered for the hospital ship in order to maximize readiness given a constraint on resources and time to deploy? Second, what are the alternatives for maintaining an uninterrupted supply channel during full operational status in support of an amphibious assault given the constraint that the ship can only carry 15 days supply of medical stores. These are the two research questions that this thesis will address. The objective is to identify a material management plan for prepositioned medical material that will minimize inventory costs for a given level of operational readiness.

C. GENERAL APPROACH AND METHODOLOGY

A literature search was conducted which included an examination of the lessons learned from countries which have faced similar medical supply planning situations. Accounts of medical support during the Falklands War were chosen for extensive examination since they represent a modern day conflict of short duration supported by long supply channels. Naval publications, instructions and manuals on prepositioned material and replenishment procedures were reviewed. Conversations were held with the *Mercy's* project management team, members of the OPNAV logistics review group, medical logistic personnel and clinical personnel.

Data regarding the process of planning for the care of combat casualties was collected from the U. S. Army Academy of Health Sciences. This research is also supplemented by one author's experience with medical material management, including experience in Vietnam, and the other author's experience with the Navy Supply System and replenishment at sea.

Conversations with project management personnel provided the authors with an understanding of the capabilities and constraints of the *Mercy*. The primary constraints upon the *Mercy's* supply planning problem are:

- Storage space for medical material is limited to a fifteen day operating level.
- Medical material must be prepositioned on board the *Mercy* while in ROS-5 so that the five day activation requirement can be accomplished.

Data from the Academy of Health Sciences provided the basis for identifying a performance measure which could be applied to the supply activities of prepositioning and replenishment. The objective of the performance measure is either to minimize operating cost, given a required level of combat readiness, or to maximize the level of combat readiness, given a specific operating cost limitation.

D. THESIS CHAPTER SUMMARY

Chapter I briefly describes the characteristics of the hospital ship *Mercy*. It shows that this ship is unlike previous ships and thus may require a significantly different approach to supply support management on the hospital ship. The material logistic support problems are briefly stated. The objective and methodology of the thesis are presented.

Chapter II discusses the provisioning and prepositioning of medical material. The DOD model for the provisioning of large deployable medical systems and the provisioning process of the *Mercy* are described and contrasted. Basic problems and alternative plans of prepositioning of medical material are discussed. Finally, an alternative approach to prepositioning medical material is presented.

Chapter III describes the replenishment of the *Mercy* during full operational status. The problems facing the Mobile Logistics Support Force because of the constrained storage space on the *Mercy* are discussed. An alternative management plan for providing supply support of medical material to the hospital ship is presented.

Finally, Chapter IV contains a summary of the chapters. Research findings and recommendations for provisioning, prepositioning and replenishment of medical material for the hospital ship are presented.

It should be noted that while this work was being done, the hospital ship's purpose, design, and medical material were still being reviewed. Thus they may change. There are many separate programs being researched and implemented that will affect the hospital ship. These programs do not detract from the validity of the findings and recommendations of this thesis but rather will complement them.

II. PROVISIONING AND PREPOSITIONING OF MEDICAL MATERIAL

A. GENERAL

The *SS Uganda* was the first hospital ship to be used by the British in over thirty years. While the conversion, as indicated in the previous chapter, was a formidable task, the supplying of the *Uganda* with the right kinds and quantities of medical material proved to be a trial and error process. When the ship set sail for the Falklands, ninety tons of medical material were onboard. In outfitting the *SS Uganda* with medical material, the British decided to take those supplies that are normally used to support a two hundred bed field hospital. Then, they augmented this by items considered essential by various clinical specialists. In writing about the Falkland experience, Surgeon Commander R. J. Leicester, RN wrote:

With regard to stores, a proper briefing and more forethought . . . might have precluded the necessity of ferrying large quantities of extra stores by air after the ship had left Gibraltar. [Ref. 1: p. 16]

Provisioning is the process to which Surgeon Commander Leicester refers. It is the process of determining the type and quantity of items required to support and maintain an end item for an initial period of service until a demand history is accumulated. [Ref. 9: p. 8] It includes two elements, first, the range or kinds of items and second, the depth or quantity of each item.

B. PROVISIONING OF DEPLOYABLE MEDICAL SYSTEMS

1. Description of Process

Four levels of deployable medical systems are identified within the Department of Defense. These levels are identified by increasing medical treatment capability, starting with the field corpsman, who represents level one, and progressing to a one thousand bed deployable medical system, such as the fleet hospital, which represents level four.

The provisioning of a level three or four deployable medical system in the Department of Defense starts with the Combat Zone Assessment Requirements (CZAR) model run by the U. S. Army Academy of Health Sciences in Fort Sam Houston, Texas. This computer model provides, through Monte-Carlo simulation,

estimates of the number and types of casualties which are forecasted to occur in a particular combat scenario. The model identifies casualties by specific medical and surgical conditions, such as fractures, gunshot wounds, or dysentery, for example.

The CZAR database contains more than three hundred distinct medical and surgical conditions to select from. For each condition selected in the simulation, the number of expected casualties is listed by the CZAR. A list of all the medical and surgical conditions considered by CZAR is contained in Appendix A. When the number of expected casualties are listed along with the condition, this output is referred to as a patient stream. This patient stream is tailored to a specific combat scenario. Table 2 contains the ten most frequent conditions for a patient stream generated for this thesis based on an amphibious assault scenario.

Each condition has a series of treatment tasks, e.g., cardiac resuscitation, physical examination or bed bath, that must be accomplished to ensure that a patient receives complete and adequate treatment. The treatment tasks from the Combat Zone Assessment requirements model serves as input into the Sets, Kits and Outfits (SKO) model. This model identifies the range and depth of consumable medical items needed to accomplish a task. Each such consumable item is identified by nomenclature, National Stock Number, unit of issue, shelf life period, other technical data and the treatment task for which it is needed. For instance, if it was required that each bed patient receive two bed baths a day instead of one, the bed bath task rate would be doubled in the SKO model. This would cause an appropriate increase in the supplies, e.g., potable water, soap, towels and washcloths, associated with giving a bed bath.

Since the treatment of each condition is just a series of tasks, the consumable medical items for each task within a condition can be summed and a list of consumable medical items needed to treat a condition can be identified. By summing the consumable medical items needed for all conditions and numbers of patients in a patient stream, a comprehensive list of consumable medical items needed to treat the casualties for a specific combat scenario for a particular length of time can be created. Normally, the length of time a patient spends aboard the *Mercy* will affect supply needs since, for each condition, treatment ends by death, transfer for further treatment, or return to duty. This length is not considered a significant factor for the *Mercy's* patient stream since the maximum length of stay on the *Mercy* is to be five days. This parameter is fed into the SKO model.

TABLE 2
TEN MOST FREQUENT MEDICAL CONDITIONS

Condition	Frequency
1. Drug Dependence (Other Than Alcohol)--Severe--Dependence and/or Addiction	109
2. Wound, Lower Leg, Open Lacerated, Penetrating, Perforating with Fracture and Nerve Vascular Damage--Moderate--Limb Salvageable	88
3. Frostbite, Superficial or Deep--Moderate--Less Than Skin Thickness Involved (First and Second Degree)	87
4. Wound, Thigh, Open, Lacerated, Penetrating, Perforating with Fracture and Nerve Vascular Damage--Moderate--Limb Salvageable	82
5. Multiple Fragment Wounds, Chest (with Pneumothorax) and Limbs with Fracture and Vascular Injury	80
6. Multiple Fragment Wounds, Chest, Upper Limbs and Abdomen with Simple Pneumothorax, Soft Tissue Injury to Limbs and Wound of Colon	70
7. Wound, Upper Arm, Open with Fractures and Nerve Injury--Moderate--Arm Salvageable, No Vascular Damage	69
8. Trenchfoot, Immersion Foot--Severe--No Vesicle Formation	68
9. Wound, Ankle, Foot, Toes, Open Penetrating, Perforating with Fractures and Nerve Vascular Injury--Moderate--Limb Salvageable	68
10. Fracture, Ankle, Foot, Closed--Severe--Displaced Requiring Reduction	56

2. Limitations of the CZAR/SKO Models

Simulation models have limitations. They must be used in a trial and error approach to arrive at a reasonable (not necessarily optimal) solution to a problem. For example, Table 2 indicates that for a particular combat scenario, 109 cases of severe drug dependence can be expected. While it may be reasonable to expect this many cases of drug dependence in long term engagements such as the Vietnam War, it is not a reasonable expectation in short term amphibious assaults such as the Grenada

Invasion. Also the inclusion of eighty-seven cases of frostbite assumes a cold weather scenario. This restricts the use of the CZAR/SKO model to forecasting needs for specific scenarios. Therefore, the output of the CZAR and SKO models is reviewed by groups of clinical specialists who adjust the outcome of the model to compensate for these limitations.

3. Using an Item Structure Tree

All deployable medical systems that are identified as level three or four are reviewed by the Joint Service Deployable Medical System Clinical Review Group of the Defense Medical Standardization Board located at Fort Detrick, Maryland. This group of clinical specialists, representing each service, is responsible for reviewing the conditions in a patient stream and then recommending specific consumables to treat these conditions. The objective is to identify a DOD-wide standard set of consumables for each specific condition.

As a result of the review group's efforts, a list of the medical consumable items needed to treat each condition is created for each deployable medical system. This approach is similar to the materials requirements planning approach, in which the number of end items is forecasted and the quantities of components needed to make the items are calculated. Figure 1.8 indicates an abbreviated item structure tree.

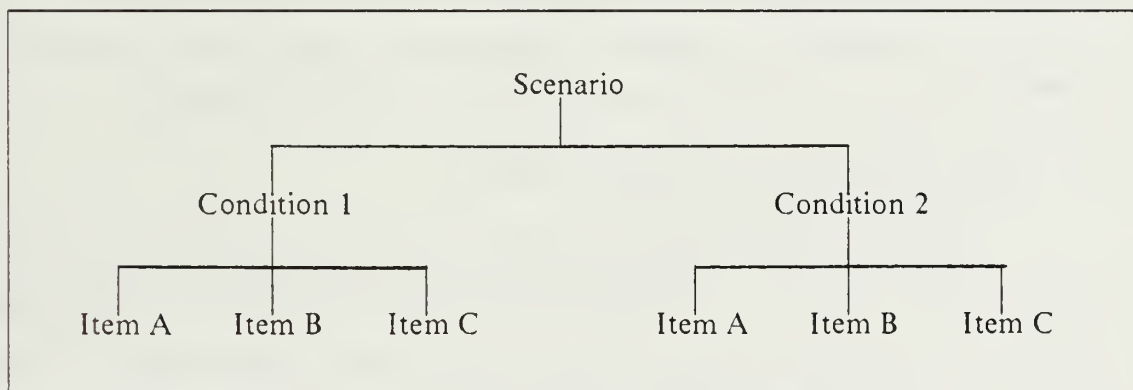


Figure 1.8 Item Structure Tree.

Material requirements planning creates a dependent demand process where the demand for components is dependent on the number of end items forecasted. In this case, the medical and surgical cases shown in Appendix A are the end items. The CZAR model forecasts the number of these. The forecasts are then adjusted by the

clinical specialists in the review group based upon their knowledge and experience. The SKO model then creates the item structure tree which supports each condition. These trees are adjusted to ensure that the most current possible medical techniques are used in the deployable medical treatment facility.

Each individual item structure tree is then summed and the result becomes a list of consumable medical items needed to treat a patient stream for a particular scenario for a specific length of time. The item structure tree for the fifth medical condition in Table 2 contains over three hundred components or consumable medical items. Appendix B displays a list of consumable medical items that are needed to treat a severe condition of immersion foot, more commonly referred to as trenchfoot. This incapacitating cold injury led to twelve percent of the admissions to the *SS Uganda* during the Falklands War. [Ref. 10: p. 25]

It should be noted that this provisioning process is an iterative process. As medical technology changes, the consumable medical items change. The item structure tree becomes the primary control mechanism. A change in the way a condition is treated can be easily made since the items needed to treat that condition can be easily identified. Also the impact of changing a consumable medical item can be evaluated since the medical and surgical conditions it supports can be easily identified. This cross referencing of consumable medical items to medical and surgical conditions allows quick reference back to the condition it supports for ease of addition, deletion and modifications as a result of change in scenario and/or medical technology.

C. PROVISIONING OF THE USNS MERCY

1. Description of the Process

The provisioning process for the *Mercy* was conducted by the Naval Medical Material Support Command (NAVMEDMATSUPCOM), then located in Philadelphia, Pennsylvania and now located at Fort Detrick, Maryland. The first step was began with a list of consumable medical items needed to support a one thousand bed communication zone fleet hospital. This hospital is a land based level four deployable medical system located in an area directly outside the combat zone called the communication zone. Items not required for shipboard use, e.g., field toilets, were deleted. This list is referred to as list "A". (For clarity, the lists will be referred to in this manner.) It should be noted that the list of medical consumable items needed to support this hospital was developed earlier using the CZAR and SKO models as described earlier.

Next, the list of medical consumable items needed to support a Combat Casualty Receiving Ship was adjusted to resemble the depth of supplies needed to support a one thousand bed hospital ship. For example, since there are only four operating rooms and three hundred beds on a Combat Casualty Receiving Ship and there are twelve operating rooms and one thousand beds on a hospital ship, the medical consumable items needed to support these two areas were increased appropriately, i.e., three times more items for the operating rooms and three and one third more items for the beds. However, a downward adjustment in depth was also necessary since the Combat Casualty Receiving Ship carries a ninety day endurance level for consumable medical items, while the *Mercy* will carry only fifteen days endurance. This list is referred to as list "B".

Then, items in list "A" were compared to items in list "B" in order to create a consolidated list "C". This comparison produced four different types of output:

- National Stock Number and quantity for a consumable medical item were the same on each list.
- National Stock Number were the same on each list but quantities were different.
- National Stock Number was on list "A" but not on list "B".
- National Stock Number was on list "B" but not on list "A".

An alpha sort on the item nomenclature was then done for the items in the last two categories to identify like items that may appear under different National Stock Numbers because of differences in unit of issue. When identical nomenclatures were found, the item was checked to see if it was on a list called the D-Day Significance List(DDSL). This is a list of consumable medical items identified as needing intense management because of their importance during mobilization. If the item was on this list, the unit of issue used on the D-Day Significance List was chosen for use in list "C".

When there was no match, either because of quantity or because of nomenclature, a judgement was made as to whether the item should be retained or deleted. If retained then the depth of this item was also determined by judgement. The judgement employed in this decision process was unquantifiable and depended entirely on the expertise of the decision maker.

Next, NAVMEDMATSUPCOM requested a patient stream from the U. S. Army Academy of Health Sciences. This patient stream was based on a combat scenario of an amphibious assault in Northern Europe. The Combat Zone Assessment

Requirements model produced a patient stream which identified a rate of admission of two hundred patients a day with a peak rate of fifty per hour and an maximum length of stay of five days. This stream was run for a fifteen day period. This resulted in an estimated receipt of three thousand casualties during the fifteen day period with an average patient load of one thousand patients.

This patient stream was then put through the Sets, Kits and Outfits model and a list of consumable medical items was compiled. This list is called list "D".

Lists "C" and "D" were then compared in a manner similar to the comparison between lists "A" and "B". The same four types of output were produced and the same decision making process was used, with the exception of depth determination. This time, when there was a quantity difference, the quantity generated from the SKO model was chosen.

Finally, as a result of this last matching process, a list of consumable medical items, needed to support a one thousand bed hospital ship for fifteen days, was produced. This list was then referred to as the hospital ship medical allowance list.

At this point, NAVMEDMATSUPCOM requested that the Surgeon General's specialty advisors come together to review this list from a clinical point of view. Logical groupings of specialty advisors were created containing specialist such as surgeons, an anesthesiologist, an operating room nurse and a pharmacist. (There was a pharmacist in all groups.) These groups recommended changes in range and depth of consumable medical items. Again, these recommendations were based on judgements which were a function of clinical expertise in a particular specialty and of possible combat experience.

The recommendations from these groups were consolidated by the Naval Medical Material Support Command and a medical allowance list was produced. After approval by Naval Medical Command, the headquarters command located in Washington, D.C., the list was referred to as an Authorized Medical Allowance List (AMAL) which also includes durable instruments and equipment. There also exists an Authorized Dental Allowance List (ADAL) for the hospital ship. The consumable medical and dental items in the AMAL/ADAL for the hospital ship are valued at nearly three million dollars, weigh three hundred tons and take up forty thousand cubic feet of space. The storage of this amount of material on the hospital ship was only possible after the addition of a 26,600 cubic feet storeroom.

2. Limitation

Unlike the provisioning process for level three and four deployable medical systems as indicated in the previous section, the item structure tree, connecting consumable medical items to medical and surgical conditions was not considered. Therefore, it is very difficult and time consuming to identify the specific types of consumable medical items used in the treatment of specific medical and surgical conditions.

This connection between items and medical conditions is further lost as the AMAL/ADAL is reviewed by additional clinical specialists. Since the hospital ship, as well as other afloat medical treatment facilities, is considered service unique by the Department of Defense, it is not classified as a level three or four deployable medical system. Therefore, the AMAL/ADAL of the hospital ship was not reviewed by the Joint Service Deployable Medical Systems Clinical Review Group. However, the AMAL/ADAL are reviewed by specialists but only from the perspective of their subspecialty. Since the majority of these follow-on reviews are conducted by single clinical specialists rather than by groups representing several subspecialties, the tendency is to add rather than delete items. One clinician may not have sufficient information concerning the importance of an item in other clinical applications. As a result, there is potential for duplication of items that perform the same function but in different medical and surgical conditions.

The inability to maintain an item structure tree requires that an independent demand approach be taken. Since there is no longer a connection between the medical condition and the consumable medical items, the number of items needed must be forecasted, independent of what they support, by using time series analysis, simulation, causal relationships or qualitative analysis [Ref. 11: p. 367]. Independent demand, because of the uncertainty in the forecasting model, leads to increased inventory levels in the form of safety stocks. The need to carry different items to perform similar functions requires separate forecasting. This leads to a requirement to have a safety level for each item. If the clinicians could agree on carrying one item vice several, the safety level of the one item will be less than the combined safety level of several items. There are costs associated with this increased inventory. Not only are there purchase costs to establish the inventory but also there are holding costs such as obsolescence, pilferage, and deterioration.

Since the *Mercy* is to be maintained in a reduced operating status and will only be used seven to fourteen days a year for operational testing, the period of service for which the ship must be provisioned cannot be determined. Under these circumstances, it will not be possible to accumulate a demand history. Even if the *Mercy* is allowed to be used to aid international relief following a natural disaster, the demand generated from this type of situation may be quite different from the patient stream which results from a combat scenario. Therefore, the AMAL/ADAL material is more appropriately being held as a contingency in case of war.

D. WAR RESERVE MATERIAL

1. Types

There are three types of war reserve materials. There is material called War Reserve Material (WRM), which represents the total amount of material needed to support combat operations for the length of the conflict. This category represents the greatest amount of material needed to maintain mobilization. The second type is called War Reserve Material Requirement (WRMR) and refers to that subset of the War Reserve Material needed to be on hand on the first day of mobilization. The last type of War Reserve Material is called Prepositioned War Reserve Material Requirement (PWRMR). This represents that subset of the War Reserve Material Requirement that is presently set aside and positioned near points of use to support an operation until replenishment can be accomplished. [Ref. 12: p. 1-4]

2. Consumable Medical Items Aboard the *Mercy*

The consumable medical items stored aboard the *Mercy* belong to the Prepositioned War Reserve Material Requirement category since the items are being positioned to support an anticipated combat scenario or to provide relief in a disaster. The prepositioning of medical material can be very costly. The Inspector General, Department of Defense has estimated that by 1990 the annual cost of replacing expired shelf-life medical items for the Pacific Theatre will be about eleven million dollars [Ref. 8: p. 2]. The costs associated with the hospital ship were not included in this estimate.

There are two reasons why the prepositioning of medical material is so costly. First, wartime requirements for limited shelf-life items can be significantly greater than peacetime consumption. Second, even if wartime stocks could be rotated with peacetime stock, the additional labor cost of removing these items from their

prepositioned storage containers and properly preparing them for shipment to a medical treatment facility may be prohibitive. Also, if the wartime requirement and peacetime consumption are not funded from the same funding source, e.g., Marine Corps funding of the wartime requirement and peacetime consumption by a naval hospital, complex financial accounting must take place.

3. Prepositioning Alternatives

At this point there exist two extreme alternatives. One is to preposition all the medical material needed to support combat operations until replenishment can occur. The other is to not preposition any medical material.

Prepositioning yields a high state of combat readiness. Reaction time in crisis situations is minimized. Also prepositioned material does not compete for transportation space at time of deployment.

However, cost is the main disadvantage of prepositioning. There are two types of costs involved: acquisition costs and support costs. Together these costs represent the life-cycle cost of the system. The acquisition cost for consumable medical items on the *Mercy* is three million dollars. The average annual holding cost, which includes costs of pilferage, obsolescence, and storage can be twenty-three percent of the acquisition cost per year or nearly seven hundred thousand dollars. These can be thought of as a cost of readiness, an insurance policy [Ref. 13: p. 14].

Cost is also an advantage to not prepositioning medical material, since holding cost is avoided. The disadvantages include a low state of readiness, competition for transportation space during mobilization and the possibility of the material not being available when needed.

E. AN ALTERNATIVE PLAN OF PREPOSITIONING

1. Need to Measure Cost Effectiveness

As indicated before, there is a cost associated with prepositioning medical material. Prepositioning also attempts to heighten a system's ability to perform its intended function. This is referred to as system effectiveness. It is a prime objective that cost and system effectiveness be balanced to achieve cost effectiveness. As long as some alternative use for resources exist, the cost of prepositioning medical material in the face of the amount of combat readiness achieved is always worthy of consideration. The need for efficient procedures for balancing cost and system effectiveness also exists. The goal of any prepositioning plan should be to maximize combat readiness by

bringing together the right amount of medical material at the right time and the right place at affordable cost.

As indicated before, prepositioned material can be thought of as an insurance policy, a cost to achieve combat readiness in view of the risk war will occur. Similarly, individuals purchase various types of insurance as a protection against the occurrence of certain events, such as accidents, injuries and death. Normally, the insurance premium is in proportion to the amount of risk the individual faces. The greater the risk, the greater the insurance premium will be. This cost of insurance is balanced with the value an individual places on life and limb. Therefore, individuals buy insurance on a cost effective basis.

Presently, the importance of combat readiness is paramount since the prepositioning of medical material will be accomplished regardless of cost. In the past, cost was paramount, since no medical material was prepositioned. Neither extreme attempts to balance cost against combat readiness. An efficient allocation of resources may not be possible under these extremes. However, tradeoffs are inevitable as long as resources are limited and competition for these resources remains intense. Presently, decision makers are not willing to make these tradeoffs by explicitly thinking about risking lives due to reductions in medical material support. The decision maker needs a mechanism for balancing operating cost and combat readiness. What is needed is a performance measure for determining the additional amount of combat readiness gained from the resources invested. This measure is important for the decision maker in terms of getting the greatest amount of readiness per dollar invested and minimizing reductions in combat readiness due to resource reduction.

2. Mission Essentiality Code

To determine how much to pay for readiness, we must identify how much a consumable medical item contributes to the medical treatment of the patient stream. In Navy supply management, this is referred to as a Military Essentiality Code (MEC). [Ref. 12: p. 2-24] This code is used by the Navy to identify the importance of a component to its end item. However, no such code exists for medical material. The information from the CZAR and SKO models can provide the elements to construct such a code.

From the patient stream, the probability of a medical and surgical condition occurring can be calculated by dividing the number of times a particular condition occurs by the total number of patients in the patient stream. Table 3 displays a sample

of twenty medical and surgical conditions, with the number of occurrences and probability of occurrence, from a patient stream produced for this thesis. The total number of casualties displayed in this patient stream was 2528.

TABLE 3
PROBABILITY OF CONDITION ON PATIENT STREAM FOR A
SCENARIO

Condition Number	Number of Occurrences	Probability of Condition Occurring
17	33	.01305
21	37	.01464
94	12	.00475
95	9	.00356
124	82	.03244
131	88	.03481
137	68	.02690
154	16	.00633
155	16	.00633
171	80	.03165
175	39	.01543
243	0	.00000
245	0	.00000
246	0	.00000
247	1	.00040
248	0	.00000
249	1	.00040
250	5	.00198
288	1	.00040
306	46	.01820
.	.	.
.	.	.
Total	2528	1.00000

The next step is to create a basic value that allows comparison across consumable medical items and medical and surgical conditions within a patient stream. Such a factor can then be used to calculate an essentiality value that could indicate how much the consumable medical item contributes to combat readiness.

The SKO model produces a consumption factor. This factor represents that portion of the unit of issue of a consumable medical item that is used to treat a particular medical or surgical condition for one patient day. The consumption factor is calculated from three components:

- quantitative expression of the consumable medical item's unit of issue

- the amount of the consumable medical item needed to treat a medical or surgical condition
- probability that a specific medical or surgical condition will require the consumable medical item

Table 4 displays the consumption factor of medical items for a number of conditions shown in Table 3 . For example, Bisacodyl is used in a total of eleven conditions, however only conditions 249 and 306 are shown in Table 4 .

The consumption factor is determined by dividing the amount of the consumable medical item needed to treat a patient condition by the quantitative expression of the item's unit of issue. This value is then multiplied by the probability that the patient condition will require the consumable medical item. For example, the consumption factor of Bisacodyl for patient condition 249 is .0004. Since the quantitative expression of Bisacodyl's unit of issue is 1000, the product of these two values is .4. The amount of Bisacodyl needed to treat patient condition 249 can be found by dividing .4 by the probability that patient condition 249 will require Bisacodyl. If the probability was twenty percent, then the amount of Bisacodyl needed would be two tablets.

It should be noted that the consumption factor can be doubled by a manufacturing or supply decision to change the quantitative expression of a single unit of issue from 1000 tablets to 500 tablets. It is important that such variability be removed so that it does not influence the computation of an essentiality index.

One alternative method to do this is to strip away from the consumption factor the probability that a patient condition will need the medication. Then the minimum consumption factor is selected to represent a single treatment unit. The remaining consumption factors (for other medical conditions) are then divided by this minimum consumption factor thereby transforming them into treatment units. This allows the consumption factor of all consumable medical items for all patient conditions to be identified in terms of a similar scalar unit. For purposes of this thesis only, the probability that a patient condition needs a medication will be treated as a constant. Therefore, the consumption factors used in Tables 4 and 5 will be treated as though the probability factor was equal to one.

By multiplying the number of treatment units of an item for a medical or surgical condition by the probability of that condition occurring, a contribution factor is created, which is weighted by the number of treatment units and the probability of occurrence of the medical condition. The sum of these contribution factors for a

particular item over all the medical and surgical conditions in the patient stream represents a raw item essentiality index that the consumable medical item provides to the patient stream.

$$E_{ik} = \sum_{j=1}^N P_{jk} X_{ij} \quad (\text{eqn 1.1})$$

where

P_{jk} = probability of condition j occurring in scenario k

X_{ij} = Number of treatment units of item i for condition j

Table 5 displays the construction of this contribution factor and the raw item essentiality index for Bisacodyl Tablets USP 5 MG 1000's.

An overall essentiality index can be obtained by summing all the raw item essentiality indices in the Authorized Medical Allowance List. By dividing each consumable medical item essentiality index by this overall essentiality index, a normalized item essentiality index for each item can be calculated.

$$\hat{E}_{ik} = \sum_{j=1}^N P_{jk} X_{ij} / \sum_{j=1}^N \sum_{k=1}^N P_{jk} X_{ij} \quad (\text{eqn 1.2})$$

Table 6 displays the normalized item essentiality indices for a six item AMAL. Items with the higher index values are more important to the patient stream.

The normalized item essentiality value of the item is peculiar to a specific scenario. This value will change as the scenario changes. This can be taken into account by determining the probability of a scenario occurring and multiplying it by the normalized item essentiality value.

$$\sum_{k=1}^L P_k \hat{E}_{ik}$$

where

TABLE 4
CONSUMPTION RATE FOR MEDICAL CONSUMABLE ITEM
FOR SPECIFIC CONDITION UNDER SCENARIO A

Condition	17	21	94	249	250	288	306
Item							
6505-00-889-9034 Bisacodyl				.0004			.0012
6505-00-904-0119 Barium Sulfate					.0500		
6505-01-067-1633 Multivitamin Inj.						.0400	
6505-01-119-7694 Sodium Chloride		.2499					
6510-01-070-1494 Collagen Hemostatic	.4166						
6550-01-173-8889 Test Kit			.0200				

TABLE 5
CONTRIBUTION FACTOR FOR BISACODYL TABLETS FOR
SCENARIO A

Condition Number	Probability of Occurrence	Consumption Rate	Treatment Units	Contribution Factor
95	.00356	.0008	2	.0071
154	.00633	.0008	2	.0127
155	.00633	.0008	2	.0127
243	.00000	.0012	3	.0000
245	.00000	.0020	5	.0000
246	.00000	.0020	5	.0000
247	.00040	.0056	14	.0008
248	.00000	.0024	6	.0000
249	.00040	.0004	1	.0004
250	.00198	.0060	15	.2970
306	.01820	.0012	3	.0546
Essentiality Index				.3853

TABLE 6
NORMALIZED ESSENTIALITY INDICES FOR SCENARIO A

Item	Essentiality Index	Normalized Essentiality Index
Bisacodyl	.3853	.5447
Barium Sulfate	.0043	.0061
Multivitamin Injection	.0004	.0006
Sodium Chloride	.1231	.1740
Collagen Hemostatic	.1643	.2310
Test Kit	.0309	.0437
Total	.7074	1.0000

L = number of possible scenarios

P_k = probability of scenario k occurring

\wedge

E_{ik} = normalized item essentiality value for item i under scenario k

This gives the contribution value of an individual medical consumable item to all items in an Authorized Medical Allowance List for a particular scenario.

The normalized item essentiality value provides an important tool to the decision maker in the resource allocation process. This value has the same purpose as the Military Essentiality Code in that it identifies the importance of a consumable medical item to the patient stream. The essentiality of a consumable medical item can be further refined by including the probability that a medical condition will need a consumable medical item. Earlier, this factor was assumed equal to one. However, this factor is, in reality, determined by clinicians to indicate how essential a consumable medical item is in treating a patient condition. It can take a value from zero to one. A new raw essentiality index for a consumable medical item can be calculated.

$$E_{ik} = \sum_{j=1}^N P_{jk} X_{ij} e_{ij} \quad (\text{eqn 1.3})$$

where

e_{ij} = probability that item i is needed to treat condition j

The new normalized essentiality index would be represented as:

$$\hat{E}_{ik} = \sum_{j=1}^N P_{jk} X_{ij} e_{ij} / \sum_{j=1}^N \sum_{i=1}^N P_{jk} X_{ij} e_{ij} \quad (\text{eqn 1.4})$$

It must be remembered that this value is only an aid in the decision process. It provides a means of making trade-offs between operating costs and combat readiness, much the same way as the cost of insurance is balanced with the value of life and limb.

3. Shelf-Life Demand Items

Once the normalized item essentiality value has been determined, the Authorized Medical Allowance List must be divided into demand and non-demand based items. Demand based items can be rotated in order to reduce shelf life losses. This distinction is determined by peacetime usage or demand of the item in medical treatment facilities. Since the wholesale distribution of medical material in DOD is centralized under the control of the Defense Logistics Agency, demand history of a medical item can be obtained from the Defense Personnel Support Center (DPSC) in Philadelphia, Pennsylvania.

Hospital ship support costs can be reduced if items can be rotated to reduce shelf life losses. Since the *USNS Mercy* will be homeported in Oakland, California, the depot at Tracy, California and the Naval Hospital at Oakland were selected for a rotation plan in order to minimize transportation cost. Since the *Mercy's* Authorized Medical Allowance List and the Naval Hospital Oakland's medical material are both Navy funded assets, interfund billing is also avoided.

Demand for an item at Naval Hospital Oakland during a shelf life must exceed the depth of the item on the Authorized Medical Allowance List of the *Mercy* in order for a medical consumable item to be considered for rotation. This criteria would

achieve the maximum benefit of reduced shelf life losses since the entire depth of an item on the *Mercy* can be rotated through the Oakland Naval Hospital. Shelf-life demand is calculated by multiplying the shelf-life of an item by the peacetime demand for that item.

For example, a one year transaction history for Ringers Injection Lactated USP 1000 ML 12's, National Stock Number 6505-00-083-6537, indicated that the Naval Hospital Oakland has a quarterly demand of 513 boxes. This demand represents only that amount shipped from the depot at Tracy, California. The shelf-life of this item is thirteen months or, when converted to quarters, 4.3 quarters. Therefore, the shelf-life demand for this item is 513 multiplied by 4.3 which equals 2205 boxes. The depth of this item on the *Mercy* is 1500 boxes. Since shelf-life demand exceeds the *Mercy* requirement, this amount could be rotated through Naval Hospital Oakland without incurring any losses due to shelf-life expiration.

One important constraint on this rotational plan is that the material with the greatest amount of shelf-life remaining needs to be shipped to the *Mercy* from the depot. There is a coding system within the Military Standard Requisitioning and Issue Procedures (MILSTRIP) which advises the military wholesaler to ship the item with the latest expiration date when desired by the requisitioner. However, the use of this advice code does not guarantee shipment of items with the latest expiration date, since the selection of such items is subject to human error. The effect of such errors can increase shelf life losses. If, in the example above, the average shelf-life remaining was 8.8 months, when received by the *Mercy*, the shelf-life demand would be below the 1500 boxes requirement for the *Mercy*.

If *Mercy* was to be designated a depot, items could be drawn from it by the Naval Hospital Oakland. This allows prepositioned items to be rotated and also has the added benefit of lowering the chances of experiencing a stockout at Naval Hospital Oakland. The range of prepositioned shelf-life items can be increased by increasing the number of peacetime medical treatment facilities that are authorized to draw from the *Mercy*. However, there is a cost of retrieving, handling and transporting this material that must be taken into consideration. This cost must be added to the cost of maintaining the material on board the *Mercy* while it is in reduced operating status. If the losses due to shelf-life expiration for an item are less than the cost of rotating the stock plus the cost of unavoidable shelf life losses, then the item should not be rotated and expiration losses taken. For example, suppose the shelf life demand of an item at

Naval Hospital Oakland is 200 boxes and the *Mercy's* depth is 500 boxes. Alternative one would be to rotate 200 boxes from the *Mercy* through Oakland. The total cost of this alternative would be the cost of administering the rotation plan plus the shelf life losses on 300 unrotated boxes aboard the *Mercy*. Alternative two would be to not rotate any stock at all. The total cost for this alternative would be the shelf life losses on 500 unrotated boxes. The alternative with the lower cost should be chosen.

4. The Model

Since financial resources for the Navy are limited, avoiding shelf life losses is important. A prepositioning model needs to identify those items which provide the greatest contribution toward combat readiness. A model capable of this can produce maximum effectiveness given a constrained peacetime resource level.

Prepositioned consumable medical items, subject to expiration dates and deterioration, should be divided into three groups based on normalized item essentiality value. The division points between the three groups are flexible.

The first group represents items that contribute the greatest amount to readiness. These items should be prepositioned to their fullest depth. Also if the shelf-life demand of an item exceeds the *Mercy's* depth for that item and the cost of rotation is less than the cost of replacement, then the item should be rotated with peacetime operating stock as much as possible.

The second group of items contributes less to the overall treatment of the patients in the patient stream than items in the first group. For shelf-life demand based items, if the cost of rotation is less than the cost of replacement, the item should be rotated. If the item should not be rotated or is a non-demand based item, then a reduced amount of the item should be prepositioned aboard the *Mercy*.

The third group contains those items that contribute the least to the patient stream. The same criteria for rotation as above should be applied. However, if the item should not be rotated or is a non-demand based item, it should be stocked as a Numeric Stockage Objective item. This item is identified as having a low normalized item essentiality value, but the lack of a unit could hamper the care and treatment of casualties until replenishment could occur.

This model only pertains to prepositioned consumable medical items. Once the *Mercy* is put in full operational status, all the items in the Authorized Medical Allowance List must be obtained. The model merely redefines, through a valuation approach, what is considered War Reserve Material Requirement and Prepositioned War Reserve Material Requirement.

F. SUMMARY

This chapter discussed the difference between the provisioning of DOD deployable medical systems and *Mercy*. It was pointed out that there is no item structure tree for the *Mercy*. The prepositioning alternatives of all or none were presented and shown not to be efficient resource allocation approaches given limited resources. An alternative model, using normalized item essentiality value and shelf-life demand approaches, was constructed and provides a means to indicate how much one may be willing to pay for a specific level of combat readiness.

III. RESUPPLY OF THE USNS MERCY

A. GENERAL

1. Authorized Medical Allowance List

The Authorized Medical Allowance List (AMAL) is the basic document which designates the types and quantities of medical supplies which are to be carried onboard U.S. naval vessels. For the *Mercy* the proposed AMAL is extensive, listing over 3500 separate medical consumables. In this AMAL there is a group of 460 medicines with a total value in excess of \$500,000. This represents 17% of the total value of the proposed AMAL. The *Mercy's* AMAL serves the medical treatment facility and is required for the *Mercy* to be self-sustaining for fifteen days at sea with a full patient capacity.

Since the *Mercy* is intended to support combat operations, resupply will take place under combat conditions. Assuming that the forecasted 200 patients per day are received, the *Mercy* will consume most of its AMAL within fifteen days. The rate of consumption of medical supplies is directly related to the condition of combat casualties being admitted. In view of the fifteen day storage capacity of the *Mercy*, resupply will be required about twice a month while in the combat support role. The supporting resupply ships will provide replenishment opportunities to any other USN vessels in the area of operations, in addition to the *Mercy*. Among the stores resupplied to other USN vessels will be medical supplies. In a wartime scenario it is important to understand that the resupply ships will provide medical supplies to all ships in the combat zone, not just to the *Mercy*.

Upon initial load out at activation from ROS-5, the *Mercy* is supposed to have its full AMAL on board. Under established supply procedures, each line item in the AMAL will have a stock record, either automated or manual, which will have an established high limit, low limit, reorder point and other requisitioning technical data. Stock balances will be determined from these records and reorders to replenish the AMAL initiated as appropriate. Additionally, internal ship's instructions will provide guidance on shelf life monitoring, rotation of limited shelf life stocks, inventory of controlled substances and general supply operations.

Mercy will be unique in that it will be operated by a civilian crew, either contract or civil service. Naval medical personnel will manage the medical treatment facility. The operation of the *Mercy* falls under the guidance of OMB Circular A-76, which covers the contracting out of certain government activities. Presently, the specifications of the request for bids for the operation of the *Mercy* are being written by the project office.

Another unique feature of the *Mercy* is that Supply Corps personnel will assume direct control of medical stocks. This control has historically been exercised by Medical Service Corps personnel. Supply Corps personnel possess familiarity with the Naval supply system while the Medical Service Corps personnel possess familiarity with the operations of the Naval Medical Command. Both specialties will bring together expertise in dealing with the appropriate Type Commander's and Fleet Commander's logistics and medical problems.

2. Resupply of the *Mercy* at Sea

During periods at sea, under normal steaming or combat support conditions, resupply of the *Mercy* will be accomplished by conventional replenishment or by vertical replenishment. Conventional replenishment (CONREP) occurs with the resupply ship along side and stores being passed by highline transfer. Vertical replenishment (VERTREP) occurs with the resupply ship helicopters ferrying supplies between the ships. The *Mercy* is configured to receive supplies by either method. While in port or at anchor, stores would be brought aboard by a pierside crane, by hand, or by small boats which would ferry material from the beach to the anchorage site.

The actual transfer of medical supplies from a resupply ship to the *Mercy* by these methods should not present any unique problems. The only foreseeable problem concerns transfer of medical stores requiring temperature control. This problem is easily solved by using insulated containers or dry ice to protect any such products. The risk of loss of supplies during a replenishment can be considered minimal.

3. Resupply of the *Mercy* in Port

Since the *Mercy* cannot be berthed at many of the world's harbors because of its size, it can be assumed that resupply in such ports will be by small boats. In this scenario, small boats will be leased from a private company or provided as part of the purchase price of the supplies. In an emergency, the *Mercy's* lifeboats could be employed to ferry stores from the beach to the anchorage site. Resupply of the *Mercy*

while at anchorage does not appear to pose a critical logistics problem because of the availability of her lifeboats.

The most significant obstacle to resupply in a port or at anchorage then concerns the acquisition of medical supplies of acceptable purity/quality in required quantities from a reliable vendor. In a port or at anchor in a friendly, industrialized nation, the acquisition of medical supplies equivalent to those meeting U.S. standards should not present insurmountable problems. In third world countries, however, problem of procuring appropriate medical supplies ranges from the availability of questionable water supplies to basic drugs of suspect quality.

Another problem would appear to be one of international politics. It is possible that a European ally could refuse to assist any U.S. naval vessels in the procurement of supplies, or allowing supplies destined for a U.S. naval vessel to transit their territory. A parallel can be drawn by citing the French refusal to allow U.S. planes from English bases to cross French air space during the 1986 raid on Libya.

This question of obtaining acceptable medical supplies by purchase in a foreign port is important because the U.S. has negotiated port visit treaties with a number of third world countries. In a combat scenario it is probable that the *Mercy* or a resupply ship would have to procure medical supplies from or through such a country. Not only would procurement of medical supplies be handicapped, but reliability of transportation systems and the availability of port services might present a problem.

The use of neutral ports for resupply presents another set of unknowns. The ability of the U.S. to use neutral ports during wartime would be decided on a case by case basis through diplomatic channels.

B. MOBILE LOGISTICS SUPPORT FORCE

1. General

Underway replenishment presents the widest range of logistics problems to resupply of the *Mercy*. Resupply of the *Mercy* while underway will be from Mobile Logistics Support Force (MLSF) ships. The primary MLSF ship to resupply naval vessels will be the Fast Combat Stores ship (AFS). The remaining MLSF ships are primarily repair/servicing ships and are not resupply ships as such. Therefore, MLSF references will mean AFS ships as their configuration and purpose is for resupply of naval combatants.

The ships of the MLSF consist of Combat Stores Ships, Destroyer Tenders, Submarine Tenders and Repair Ships. The MLSF has the responsibility of providing the Operating Forces with resupply and repair support at sea. [Ref. 14: p. 1-1]

In a combat situation, positions of ships are classified, as are underway replenishment locations and times. This by itself presents a problem in interpreting the Geneva Accords:

In particular, hospital ships may not possess or use a secret code for their wireless or other means of communication. [Ref. 15: p. 144]

Literal interpretation of this article indicates that underway replenishment times and locations must be transmitted to and from the hospital ships in plain language thereby making the resupply ship vulnerable to attack by any enemy means. The prevention of the underway replenishment, or the loss of the resupply ship would directly affect the ability of the hospital ship to perform its primary mission.

Resolving this interpretation of the Convention is left to the parties to the Geneva Conventions. The point is raised only to show the range of management problems on the *Mercy* which may require future resolution.

2. Resupply Pipeline

Shelf life and its effect on hospital ship medical assistance has been addressed previously. When the entire resupply pipeline is viewed, from the producer to ultimate delivery onboard the hospital ship, shelf life takes on a more critical role. Continuing the assumption that the *Mercy* is operating in a combat situation, the resupply pipeline may become erratic. Rapid and secure transportation of medical supplies destined for the *Mercy* can probably be assured in the continental United States (CONUS). However, when these medical supplies are moved beyond CONUS, there is no assurance of a direct and rapid flow through military or other channels to the *Mercy*. Under combat conditions, the only assured supply to the Fleets may be limited to materials carried by ships of the MLSF. The resupply of the MLSF itself will depend on nearness to a friendly port capable of receiving the medical supplies, providing proper custody, and the facilities to rapidly load the MLSF. Allied third world nations may be unable to provide these services especially when a war is going on.

Presently, MLSF ships are resupplied at Pacific and Atlantic ports under complete or partial U.S. military control in allied nations. Due to the length of the

supply pipeline and area covered in the Western Pacific (WESTPAC) by MLSF ships. Naval Supply Depots (NSD) are strategically located to augment the supply chain and provide support to all U.S. naval vessels. In the Mediterranean and Atlantic operating areas, the MLSF is used almost exclusively to resupply the fleet as there are no NSDs strategically located in these areas. In a combat situation, the MLSF ships would be targeted for attack by the enemy. It can be reasonably assumed that the MLSF ships would use circuitous routes between supply bases and customers, in addition to standard evasive maneuvers. This indirect steaming between resupply ports and the *Mercy* delays delivery of medical stores and creates perishability problems.

The fifteen day storage capacity of the *Mercy* will require frequent underway replenishments in order to maintain sufficient medical stores to continue its mission to provide medical care to combat casualties. Even a conflict of limited duration, i.e., 60 - 90 days, would require numerous replenishments of the *Mercy*. The increased frequency of underway replenishments logically leads to an increased frequency of MLSF ship visits to its resupply base and thus to increased chance of enemy attack. Again, perishability problems increase with each delay.

A clearcut solution to the overseas resupply lines problem is not readily apparent. Increased use of the Military Airlift Command (MAC) flights to carry supplies to MLSF/hospital ship resupply ports may help. However, in wartime there will be increased competition for space on MAC aircraft. Continued refinement of tactics, improved defensive weapons for MLSF ships and secure sealanes will improve MLSF ships' security. Unfortunately they will remain targets for enemy attack.

3. Fleet Item Load List

While the AMAL designates the range and depth of medical supplies carried onboard the *Mercy*, the load aboard an AFS is based on demands forecasted from fleet data. The Fleet Issue Load List (FILL) is the sum total of for-issue supplies carried aboard an AFS.

1. **PURPOSE.** The FILL (Fleet Issue Load List) serves a dual purpose.

a. It represents the range of PWRs (Prepositioned War Reserve) material carried on board combat store ships of the Fleet to support projected requirements of deployed forces under mobilization conditions. The PWRs designation and computed range are in accordance with criteria prescribed by the CNO (Chief of Naval Operations) directive 4441.12 (series) as modified by CNO message.

b. It serves as a shopping guide for deployed Fleet units to requisition material carried by the AFS (Combat Store Ship). The FILL is based on actual demands from deployed Fleet units and includes items most requested, plus a limited number of items to support CNO designated weapons systems/equipments. [Ref. 16: p. 1]

The Uniform Inventory Control Programs (UICP) Load List operations are designed to determine the variety of items (range) and the quantity (depth) that should be included on MLSF loads. In making the necessary computations, the operations consider the desired degree of support, the expected demand for the items, and the special circumstances related to new or critical equipments. [Ref. 14: p. 1-2]

The UICP Load List operations performed at Ships Parts Control Center (SPCC), Mechanicsburg, Pennsylvania, estimate demand for each item for a defined period of time. For consumable items, including medical consumables, the forecasted demand is based on past demand. In the case of the *Mercy*, there is no recorded demand on file for most of the medical stores in the AMAL. The demand existing on file is demand registered by U.S. Navy combatant ships. While this demand is a viable means to forecast expected demand of the *Mercy*, the range of medical supplies requisitioned by combatants is considerably less than the range of medical consumables the *Mercy* would requisition. The quantities demanded by the *Mercy* can also be expected to exceed those of combatants.

The derivation of the AMAL was outlined previously in Chapter II. The important point is that the AMAL is computed to have sufficient quantities of a broad spectrum of medical supplies available to treat anticipated wartime casualties. Casualties treated in *Mercy* will range from minor wounds, setting broken appendages to major surgery. U.S., allied, and enemy casualties will be treated aboard the *Mercy*. The *Mercy* is an afloat trauma center capable of handling any type of casualty. The proposed AMAL reflects this capability by the diverse drugs and other medical consumables carried. Lack of any of the AMAL requirements hampers the ability of the *Mercy* to fulfill her mission.

The load list operations compute a forecasted demand based on past demand using the MLSF demand file, a file containing the latest 24 months of demand. The MLSF demand file is a compilation of demand reported by MLSF ships/activities and stock points. The result of the Load List operations is the single FILL. The single FILL is used by AFSs of the Atlantic and Pacific Fleets. Under the single FILL concept, all AFSs carry the same range of items, but with varying depths. Appendices C and D show a breakdown of items, by cog, carried on Atlantic and Pacific Fleet AFSs. Previously, AFSs of the Atlantic and Pacific Fleets maintained separate FILLs. These separate FILLs provided support to different ships, computed range and depth differently and were loaded on different AFSs. The operations experience in the Indian

Ocean and Vietnam demonstrated the problems with this concept. Atlantic Fleet AFSs deployed to the Western Pacific and the Indian Ocean were supporting Pacific Fleet ships. Atlantic Fleet ships deployed to the Indian Ocean and were supported by Pacific Fleet AFSs. The differences between demands and level of AFS support resulted in the decision in 1983 to compute a FILL which would be used by all MLSF ships and would have a common range of items. Unfortunately the single FILL probably does not contain the items needed to provide adequate resupply to the *Mercy*. [Ref. 17: p. 1.6-26]

4. Computation of Medical Consumables for the FILL

The 9L cog medical consumables are computed jointly by SPCC and the Navy Medical Material Support Command (NAVMEDMATSUPCOM). NAVMEDMAT SUPCOM determines which 9L cog medical items are authorized to be carried on an AFS FILL. NAVMEDMATSUPCOM provides this information to SPCC. In turn, SPCC processes the National Stock Numbers (NSN) through the load list operations. The NSNs are first compared with the MLSF demand file. If the NAVMEDMATSUPCOM authorized NSN does not appear on the demand file, that particular NSN is deleted and no further action is taken on it. If the NAVMEDMATSUPCOM authorized NSN does appear on the MLSF demand file it is further processed through the demand forecasting portion of the load list operations. If no demand is forecasted for these NSNs, they are deleted and no further action is taken on them. The NSNs which match the MLSF demand file and have a forecasted demand calculated then become part of the FILL.

Because the *Mercy* has not been accepted by the Navy, no demands have been submitted for its AMAL requirements. Only medical items which have been demanded by all other U.S. Navy ships are included in the MLSF demand file, and only demands placed in the preceeding 24 months. *Mercy's* AMAL requirements exceed the requirements of the largest U.S. Navy ships. It can therefore be assumed that the MLSF demand file is missing medical supplies which are unique to the *Mercy*. The result is that the load list operations will not compute an AFS FILL which will adequately support the *Mercy*.

The 1 September 1986 single FILL includes 416 separate 9L cog items. 220 of these are drugs and 196 are nondrug consumables. The proposed AMAL for the *Mercy* lists 3602 line items, 3457 of them being medical consumables. These 3457 line items are made up of 460 drugs and 2997 non drug consumables. If the *Mercy* were to

proceed to a combat situation today, the supporting AFS, using the 1 September 1986 FILL, would at best be able to provide only 47.8% of the *Mercy's* drug requisitions and 6.54% of the non-drug medical consumable needs, or a grand total of only 12.03% of all 9L cog requirements. These are the maximum fill rates assuming that the 416 FILL items are all included in the *Mercy's* AMAL. That is not the case.

There is no intent to imply that problems exist with the computation of the FILL or with the support provided by an AFS. The AFS FILL carries the medical items which have been validated by the SPCC load list operations. However, the load list operations calculate medical stores for the FILL based on data provided by NAVMEDMATSUPCOM. It is this link where resupply of the *Mercy* may be the weakest. The items authorized by NAVMEDMATSUPCOM to be carried on an AFS are selected by value judgement rather than a statistical method. Additionally, Fleet Commander-in-Chief (CINC) and Type Commanders (TYCOM), Systems Commands and Program Managers, as a matter of policy promulgated by Naval Supply Systems Command (NAVSUP) are required to:

- (5) provide specific changes to load lists based upon Fleet requirements (2)
Provide detailed planning information concerning end items application, population, and deployment to the program support Inventory Control Point (ICP) during the provisioning process so that the ICP can include MLSF load list requirements in provisioning requirements determinations. [Ref. 18: p. 2]

Even after the DOD Inspector General's *Report on the Audit of Medical Support in the Pacific*, there is no indication that load list overrides for *Mercy's* requirements for inclusion in the FILL have been forwarded to SPCC. Nor is there reason to believe that any action is in process to document the *Mercy's* AMAL requirements for FILL calculation.

As pointed out in Chapter II, the process whereby the AMAL is derived relies heavily on the value judgements made by numerous medical groups. This is not to imply that this is an incorrect procedure, but that the value judgements are not connected to the available quantitative data. Fleet Medical Officers also do not presently provide active input to the AMAL development process. It is the Fleet Medical Officer who has the best personal knowledge of the overall requirements of afloat medical personnel.

By having the Fleet Medical Officer review the *Mercy* AMAL and the NAVMEDMATSUPCOM input to load list operations, the overall quality of afloat

logistics support for medical needs can be improved from an afloat perspective. The *Mercy* is, after all, a floating hospital which will require logistics support different from a shore based hospital. Those requirements will range from range/depth levels and resupply, to storage space and ability to rapidly acquire critical medical supplies. It can be seen from the DOD Inspector General's audit report that logistics support planning for the *Mercy* has been less than optimal. There is no indication that the afloat medical community has been actively involved in any planning for logistics support for the *Mercy*, let alone assisting in the resupply logistics planning.

C. RECOMMENDATIONS

1. General

Clearly, changes to the FILL are required in order to provide support to a deployed hospital ship in a combat scenario. Commanders in Chief/Type Commanders can recommend FILL parameter changes to the Commander, Naval Supply Systems Command. [Ref. 18: p. 2] However, because of storage space limitations onboard an AFS, additions to range and depth of medical consumables may occur at the expense of other FILL commodities. It is not sufficient to include the full *Mercy* AMAL in the FILL and assume optimum support is available. Ownership costs of the medical supplies would tend to increase unabated. Therefore a restrained increase in the FILL is desired. Using the insurance analogy from Chapter II, that equates to buying medical insurance or life insurance on a fixed income.

FILL changes for 9L cog consumables need to be initiated by NAVMEDMATSUPCOM. However, to ensure that the FILL adequately reflects the *Mercy*'s requirements, the Fleet Medical Officer should be an active participant. In this way, the Fleet Commanders and Type Commanders will be in a position to more rapidly affect the FILL rather than reacting to the FILL after the fact.

Arbitrarily adding sufficient range and depth of medical supplies to the AFS to support *Mercy* is not cost effective. Besides risking the decrease in range or depth of other commodities carried on an AFS, there is a higher probability that losses due to expiration of shelf life of medical stores for the *Mercy* will be incurred. Again, there is logical reference to insurance costs. In addition to the addressed insurance aspects of maintaining a full AMAL on *Mercy* at all times, a comparison can be made to maintaining a complete stock of medical supplies on the AFS. If the *Mercy* were to be operational only 7-14 days annually, arbitrarily increasing the AFS range and depth of

medical stores to support the *Mercy* would not be cost effective. Besides risking a decrease in range or depth of other commodities carried on the AFS, there is a higher probability that losses due to expiration of shelf life of medical stores would be incurred. However, during wartime, if the AFSs do not carry sufficient range and depth of medical supplies, there is a very high probability that the *Mercy* will not have access to medical supplies for replenishment. This could result in an unnecessary loss of human life.

2. Essentiality Index

Referring to the proposal in Chapter II, essentiality indices can be applied to the 9L medical supplies carried in the FILL. The AFS would carry essentiality group I medical stores at all times in the calculated range and depth. Each essentiality group would be treated a bit differently. For essentiality group I items carried on an AFS which have fleetwide demand, a reservation level could be applied to ensure adequate quantities would be available to replenish the *Mercy*. No reservation level would be necessary for essentiality group I medical supplies unique to the *Mercy*. Medical supplies which fall into essentiality group II would be carried onboard the AFS in quantities sufficient to meet the forecasted demand of all U.S. Navy ships with the exception of the *Mercy*. In wartime the range and depth of these items would be increased to meet the forecasted demands of the *Mercy*. Essentiality group III items would be stocked at the Specialized Support Point (SSP) closest to the homeport of the hospital ships as a Numeric Stocking Objective (NSO), or at an overseas base as an NSO.

By applying the essentiality index to medical stores onboard an AFS, costs are contained, a higher level of support for the *Mercy* in a combat scenario is available and the supply pipeline would have the data necessary to expedite procurement of critical medical supplies when required. Such a procedure is presently used to monitor repair parts for critical weapons systems.

Determining what to include in a FILL to support a hospital ship is not an easy task. There is no past demand for a hospital ship. Medical technology has advanced since the last hospital ship was on active duty. There is a financial limit on how much can be invested in medical supplies. Application of an essentiality index can aid in the production of the FILL. This index can be used by medical groups reviewing the AMAL to rank the medical supplies by the overall contribution to a cure rate. The essentiality index would be a means to support the value judgements made by the medical review groups.

The CZAR and SKO outputs used in this thesis are based on only one wartime scenario. The CZAR model can generate multiple war scenarios with the resulting forecasted patient streams. The SKO model produces the list of medical supplies needed to treat this patient stream. By having the CZAR model produce wartime scenarios by climate condition, arctic and temperate, alternate patient streams can be generated. The the SKO model could generate listings of medical supplies by climatic condition. The expected result would be the creation of two AMALs adjusted to climate conditions. Further refinement of these AMALs would then create one joint AMAL which would carry items common to the two climate specific AMALs.

The joint AMAL and the two climate specific AMALs would then have the essentiality index applies. All items on the joint AMAL which would meet the requirements of doubling as backup stock for Naval Hospital Oakland would become the core of the medical stores kept onboard the *Mercy*. All other items on the joint AMAL would be loaded onboard upon activation. In addition, the appropriate climate specific AMAL would also be loaded onboard upon activation, depending on the planned destination of the *Mercy*.

Given the ability to climatize the AMAL, it should also be feasible to create climate specific FILLs for the AFSs. A contingency FILL for medical supplies only can be developed. The AFS FILL would carry the essentiality group I items from the joint AMAL. Those items which are computed to have fleetwide demand would have reservations levels applied for *Mercy* requirements. Essentiality group II and III climate specific medical items would be handled by the AFS as described earlier in this chapter. Upon activation of the *Mercy*, any AFSs which would resupply the *Mercy* would take on the appropriate range and depth of medical supplies to support the climate specific AMAL based on the predetermined destination of the *Mercy*. Any increases in the range and depth would be at the expense of any essentiality group II medical items already onboard the AFS which were not appropriate for the climate conditions expected.

Since the AFS load is financed by the Navy Stock Fund, there is no apparent impediment to purchasing any increases of range or depth of medical supplies for the AFS load. To further improve the accuracy of demand from the *Mercy*, a special project code could be assigned which would be used for all 9L cog medical requisitions from the *Mercy*. This would provide a higher level of visibility for medical stores than regular demand observations or classing demands by routing identifier code.

The availability of sufficient storage space aboard the AFS remains a limiting factor. Application of the proposed essentiality index would provide a means to control the cubic feet of space required to hold the medical stores for the *Mercy*. In addition, any future increases in the range of depth 9L cog material carried on the AFS because of changes in the AMAL could be better managed by using the essentiality index. The essentiality index would help limit the range of items increased and by reacting to advances in medical technology.

3. Increase Mercy Storage Capacity

Increasing storage space onboard *Mercy* is a feasible alternative to decreasing dependency on the AFS. The present storage capacity of the *Mercy* was achieved by the addition of a space on the 03 level. But because this space is exposed on all sides to the weather, temperature changes outside affect interior temperatures which in turn may affect any items requiring temperature and/or humidity control. Even with the addition of insulation, this storage space can not be relied upon to maintain the constant temperature and humidity levels required for storing sensitive medical supplies. This added storage space is suitable only for nonperishable medical consumables. Therefore, any further increases to the *Mercy's* storage capacity should be below decks.

If the storage capacity in *Mercy* were to be increased beyond what presently exists, a choice would then have to be made between maintaining increased AMAL requirements onboard during ROS-5 or bringing increased quantities onboard at activation. Storing additional medical material onboard during ROS-5 without considering a rotation plan through Naval Hospital Oakland would tend to increase financial losses due to expired shelf life. If the decision is to bring increased quantities of needed medical material onboard at activation, the *Mercy* would be capable of going longer periods between replenishments from an AFS. In both cases, the *Mercy* would be self-sufficient for longer periods at sea. Because of fewer required replenishments resulting from this increase in self-sufficiency, the AFS could theoretically carry reduced quantities of medical supplies for the *Mercy*. If adjustments in the AFS load of medical stores for *Mercy* support are not made because of the increased time between *Mercy* replenishments, some increase in losses due to expired shelf life onboard the AFS can be expected.

Whatever is ultimately decided, there needs to be a method of ranking medical consumables by usefulness or essentiality. It is not realistic to expect that every

medical item necessary to treat every form of casualty or disease can be carried onboard *Mercy* or an AFS. The initial investment cost plus holding costs would eventually prohibit any increases in the range of items carried. First there must be acceptance of the concept that not every casualty can be saved; loss of life because of shortages of some medical supplies is inevitable even in the best designed and managed supply system. The solution is to assign some essentiality index to medical items. This would ensure that the consumables providing the best cure rate would be available to meet the widest range of casualties while staying within a dollar and space limitation.

Competition for storage space onboard the present AFSs can only increase as new weapons systems are added to the fleet and the number of repair parts to be carried on an AFS increases. It is not reasonable to expect that repair parts inventories will decrease as the range and depth of medical consumables increases. It is essential that the AFSs carry the optimum mix which will afford the fleet access to the most essential items to repair weapons systems and provide medical assistance to the injured.

Competition for defense funds between repair parts and medical consumables can only increase. It is essential that the optimum quantities of the most essential supplies be procured and stocked.

IV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. CHAPTER SUMMARIES

1. Provisioning

This chapter reviews some of the issues presented in Chapters II and III and draws together the findings that emerged. These findings are then converted into recommendations in order to improve supply support to the hospital ship from an integrated logistic support perspective.

While the concept of an active hospital ship for the US Navy has been under consideration since the late 1970s, it was the British Royal Navy which proved the necessity of such a ship from their experience during the Falkland's War of 1983. During actual wartime preparations, an education cruiser was transformed into a floating hospital in 65 hours. The value of the hospital ship to the Royal Navy could be counted in the lives saved, both British and Argentinian.

Even by today's standards, the *USNS Mercy* is an impressive vessel. With the capacity to hold 1000 casualties plus a full crew, 12 operating suites, and state of the art equipment, the *Mercy* is an afloat trauma center capable of dealing with any casualty condition. The finest treatment facility anywhere is, however, limited by the availability of medical supplies. This is also true of the *Mercy*.

From the start of the conversion of an oil tanker into a first class hospital ship, the development of the *USNS Mercy* has not received optimum integrated logistics support. As recently as January 1986, OPNAV identified 14 deficiencies relating to logistics support, both internal outfitting logistics and continuing logistics support after acceptance of the *Mercy* by the U.S. Navy.

This thesis undertook the task of looking at a narrow aspect of the integrated logistic support plan, namely material support of medical consumables. The authors relied heavily on their professional experience in the Medical Service Corps and the Supply Corps, performed extensive files research and interviewed program management personnel, Medical Service Corps personnel and Supply Corps personnel. The results of this investigation convinced the authors that little progress in improving the material logistics support of the *Mercy* had taken place, even after the OPNAV findings were released.

The *Mercy's* present storage capacity will allow for fifteen days at sea with a full patient load. This capacity was only recently increased to fifteen days by the addition of a storeroom to the 03 level. Storage capacity is critical because the more medical supplies the *Mercy* carries during a wartime scenario, the longer the *Mercy* can stay on or near the combat zone and treat the wounded. Times between replenishments can be extended, thereby increasing the time spent on station.

Provisioning for medical stores is dissimilar from provisioning for repair parts. Medical science has not yet attained the sophistication wherein organs and limbs can be stored for extended periods and issued upon request.

Hence, military medicine has statistically computed the probability of casualties and wounds using the CZAR model. The model is run for various combat scenarios. The output from the CZAR model is subsequently run through the SKO model. This model produces a listing of medical consumables required to treat the casualty/wounds computed in the CZAR model. The SKO output defines national stock number, nomenclature, unit of issue, shelf life code, range, depth and further technical data.

After a series of reviews by clinical specialists and final approval by Naval Medical Command, the AMAL is used to provision the *Mercy*. In-depth discussion of the clinical specialists' review of the rough AMAL was given in Chapter II. It is readily apparent that a better AMAL is not achieved by this singular review as opposed to the benefits of a joint review. It is recommended that NAVMEDMATSUPCOM review the existing procedures used to derive the AMAL. This review should also ascertain what benefits can be achieved from a joint review vice the present method of review.

The cost of the items on the AMAL was then considered. Not only is the procurement cost considered, but holding costs, costs due to expired shelf life, prepositioning costs and the costs of no prepositioning (i.e., shortage costs) were considered. Two extremes are presented: preposition medical supplies or not preposition medical supplies. As with any public expenditure for defense, accountability and responsibility are paramount. It is no longer possible to procure endless quantities of any item. Chapter II expanded the costs associated with prepositioning/not prepositioning and the resulting payoffs.

Because the risk of injury is eternally present, minimizing that risk is undertaken throughout the U.S. by purchasing insurance. Medical costs in the military

equate to the costs incurred in prepositioning medical material, i.e., the price of insurance. A high insurance cost can be incurred by prepositioning, or negligible insurance costs can be incurred by not prepositioning medical supplies. Both aspects of prepositioning were presented. Throughout the economic sphere, it is understood that the concept of maximizing a measure of system performance at no cost is an unreachable goal. In the case of medical supplies for the *Mercy*, the Navy is attempting to maximize the number of lives saved in a combat situation given limitations on storage space and peacetime budgets. While budget can be increased when necessary, sufficient storage space to carry all medical supplies to treat all possible casualties and wounds expected to be encountered in a war is simply not available onboard the *Mercy*.

Repair parts are assigned an Item Mission Essentiality Code. This code identifies the degree of criticality of the part to the weapon system or the criticality of the weapon system itself. Chapter II contains a proposal to assign a similar essentiality index to the consumable medical items. The example cited is a simple application of a measurement/ranking system. It is possible to rank medical supplies by their degree of criticality to healing the sick and wounded. Application of this Essentiality Index to AMAL requirements provides a means to identify the most essential life saving medical supplies and further enables a logistician to apportion storage space or funding by essentiality of the commodity. In an environment of limited budgets, the investment of defense dollars in medical supplies is enhanced by procuring the most essential materials ahead of the less essential materials.

Attention to shelf life is necessary to ensure that the essentiality index is made a viable inventory tool. Shelf life management is a basic element of any warehouse management operation. However, shelf life management of medical supplies, especially drugs, is critical to ensuring the ability of the *Mercy* to perform its mission. Expired essential drugs will provide little, if any, healing capacity to the combat wounded. There is also the financial loss associated with expiration before use.

Provisioning the *Mercy* is only the first step in the logistics support process. In the ROS-5 scenario, a proposal has been presented wherein stores are rotated through the *Mercy* on their way to Naval Hospital Oakland. Utilizing the *Mercy* as a quasi-stock point would aid in decreasing losses of medical stores due to expired shelf life. Since Naval Hospital Oakland does not now enjoy the benefit of a backup source of supply, having the *Mercy* serve in this capacity would supply support to Naval

Hospital Oakland at very low cost. To be a viable backup supply point, however, the tradeoff of costs outlined in Chapter II would have to be made. There are certain supply/requisitioning procedures which would need finalization for this proposal to work, but the authors are of the opinion this can be accomplished easily. Further study will define the specific procedures to allow Naval Hospital Oakland to draw stores from the *Mercy*, with the *Mercy* requisitioning replenishment quantities from the supply system.

2. Replenishment

The resupply of the *Mercy* in a combat scenario is somewhat complex. This ship will not fit into many of the world's harbors because of its size. Therefore, to receive any resupply in a port, *Mercy* would have to anchor out and utilize lifeboats or leased boats to ferry stores. This is not an uncommon practice for the larger ships of the U.S. Fleets.

Resupply underway presents a wide range of possibilities. Normal underway replenishments are not simple operations; wartime adds to their level of complexity. By Geneva Protocol, hospital ships are immune to attack by any enemy. There is no intent to discuss the realities of politics here. In combat, the resupply ships are considered targets. During an underway replenishment, or the approaching underway replenishment any enemy attack on the resupply ship could prove lethal to the hospital ship.

Referring to the insurance analogy earlier, the AFS is insurance that the *Mercy* will have essential medical supplies available to replenish depleted consumer level stores. However, the AFS carries a wide range of stores, repair parts, provisions, general service goods, in addition to medical items. The competition for space dictates that only essential commodities be carried onboard the AFS. Chapter III described the range of medical consumables required on the *Mercy* and the range of medical consumables carried by the AFS. A large discrepancy was observed between requirements and fill rates. Obviously, the AFS can not carry one hundred percent of the items which will be requested by any U.S. naval ship, let alone a hospital ship.

Applying the essentiality index to the medical consumables on the AFS would help reduce this perpetual problem. By ensuring that the AFS carry the most essential supplies for the *Mercy*, mission impairment of the *Mercy* will be reduced. In addition to the improved reliability of the AFS, the bases which resupply the AFS would also be in a better position to manage medical supplies. Group I items could be handled

under the Selected Item Management procedures, replacing every issue with a requisition from the wholesale stock system. Essentiality group II items could be requisitioned from wholesale at a predetermined reorder point and essentiality group III items could be treated as Numeric Stockage Objectives.

The supply pipeline from producer to the *Mercy* will become erratic in combat situations. Applying an essentiality index would enable military procurement and logistics experts to expedite the most critical and essential items first, the essentiality group II items and finally the essentiality group III items. Attention would be focused on the medical supplies which would provide the most life saving capacity.

To further improve the ability of the AFS to support the *Mercy* in wartime, the FILL could be tailored to fit arctic conditions or temperate conditions. The CZAR/SKO outputs used in this thesis are only one of the numerous combat conditions which can be statistically forecasted. By stratifying combat conditions by climate, it becomes possible to tailor the medical portion of the FILL to suit the appropriate climatic war zone. The supplies which are common between the temperate and arctic climatic combat zones then become the constant AFS load of medical supplies subject to the essentiality index. Additions can then be made depending on the expected climatic conditions of the war zones. An alternative would be to split the climatic requirements between AFSs. AFSs deploying to the north Pacific or Atlantic could carry the arctic climate AMAL supplies. For AFSs deploying to the south Pacific or Atlantic, the temperate climate AMAL supplies would be loaded aboard.

The cost benefits combined with the life saving benefits can be calculated. The investment becomes constrained and limited storage space can be optimized. Maintenance of the medical supplies then becomes more critical, but should, in fact, be simplified. Fewer items will be managed which will ease management decision, improve inventory accuracy and reduce investment costs. By integrating the supply and medical stock management expertise onboard the *Mercy*, overall medical supply support should be maximized.

B. GENERAL FINDINGS FOR PROVISIONING

The following section draws together three general findings regarding the prepositioning of medical consumable items. The findings are a) the need to classify the hospital ship as a Department of Defense level four deployable medical system, b)

the use of a normalized essentiality index, and c) devising a shelf life demand rotational plan.

1. Classification of the Hospital Ship

While it is apparent that a shipboard deployable medical system may contain consumable items which are different from those used in a field deployable medical system, the types of conditions and injuries that are treated in both systems are very similar. Since the patient flow will normally proceed from a deployable medical system located in the combat zone to the hospital ship, the degree of treatment rendered to the patient will be different at each location. Also some conditions will need minimal treatment and the individual can be returned to full duty in a few days. This would indicate that there are going to be some similar items needed to support both types of deployable medical systems. Further evidence of this degree of similarity of consumable medical items exists from the fact that the initial provisioning process of the *Mercy* started with a list of medical consumable items needed to support a level four deployable medical system (Fleet Hospital). Not only did the *Mercy's* Authorized Medical Allowance List start with the SKO model but it also ended with the SKO model in the last matching process.

By classifying the hospital ship as a level four deployable medical system, the item structure tree, as shown in Figure 1.8 can remain intact. This allows for a more analytical and auditable approach to updating the Authorized Medical Allowance List when a change in scenario or medical procedures occurs.

2. Normalized Essentiality Index

It is difficult to evaluate how one medical item may be more important than another, especially where there is a heavy interdependence of medicines in the treatment of a condition. However, without some method of evaluating how much an item contributes to the overall mission of the hospital ship, all items are considered equal by default. Therefore they will have equal demand on resources. Yet some inventory methods depend on identifying those high demand items as being more important to the production process and so receive more intense management. Since there is no combat demand upon which to base the range and depth of consumable medical items, another method must be developed to achieve a cost effective balance between constrained financial resources and combat readiness.

The normalized item essentiality index attempts to identify how much an item contributes to healing the patients who come aboard the *Mercy*. Obviously some items

contribute more than others since they are demanded more often. This is part of the function of the index. It allows decision makers to allocate limited resources to those items that are demanded most frequently. The index also partly represents the relative importance attached to the item with regard to its use in treating the listed medical conditions.

3. Shelf Life Demand Rotation Plan

The Department of Defense Inspector General recommended that prepositioned medical stocks with less than twelve months of remaining shelf life be reported to the Defense European and Pacific Redistribution Activity. [Ref. 8: p. 5] These prepositioned assets would be matched against peacetime demands for these items. When a match occurred, the peacetime demand would be satisfied from the prepositioned asset. This asset would then be replenished from the wholesale level with a newly manufactured item.

The rotational plan identified in Chapter II attempts to achieve the same objective but on a much smaller scale. By limiting the rotational plan to the Naval Hospital at Oakland and the Defense Depot at Tracy, transportation costs can be minimized. Also the problem of cross servicing of funds is avoided. Prepositioned medical material can be funded in a centralized manner under Department of Defense and through a revolving fund concept that would eliminate the need to address the cross servicing of funds.

The Department of Defense Inspector General recognized the need to link the prepositioning of medical material with the peacetime usage of these items in the peacetime medical treatment facilities. Two aspects of a rotational plan must be considered, simultaneously. The first aspect deals with the effect of the deployable medical system on the peacetime medical treatment facility. Care must be taken to ensure that there is no degradation of supply support to medical treatment facilities when actual deployment of the *Mercy* occurs.

The other aspect deals with the effect of the medical treatment facility on the deployable medical system. If patient usage of the medical treatment facilities decreases because certain categories of eligible beneficiaries can no longer receive care, then the demand for medical consumable items will also decrease. This will decrease the amount of prepositioned assets that can be rotated through peacetime medical treatment facilities. The result may be that more prepositioned medical consumable items will expire before rotation can be effected and the cost of readiness will increase.

C. GENERAL FINDINGS ON REPLENISHMENT

From a logistics standpoint, the AFS can not provide but a portion of the *Mercy's* medical requirements based on the current FILL. During peacetime this does not present a problem, as the *Mercy* will be tied to a pier. During a wartime scenario, this could become a critical factor affecting the survival rate of casualties, which in turn affects the percent of healed personnel returned to the combat zone.

1. FILL Changes

The speed of the *Mercy* (approximately 17 knots) is such that the time to transit from a position of combat support to a friendly port for resupply would exceed the transit time for an AFS (approximate speed 20 knots) to depart the friendly port to the combat zone to resupply the *Mercy*. From a transportation point of view, it is more effective to have the AFS come to the *Mercy* for resupply evolutions. This would allow the *Mercy* to stay in the combat zone longer to receive the wounded. But the medical supplies listed in the current FILL and carried on the AFS would have to be increased sufficiently to provide the effectiveness levels directed by the Chief of Naval Operations. Under the 1 September 1986 FILL, an AFS would be able to achieve only a gross material availability of all 9L cog items of 12.03%, and a gross material availability of only 47.8% for drugs. These gross material availability levels are based on 416 9L cog FILL items divided by 3457 *Mercy* 9L cog demands and 220 FILL drugs divided by 460 *Mercy* drug demands. Both cases fall far below the CNO goal of 65% Gross Material Availability. From an overall perspective, the FILL carries 149 drugs of the 460 listed on the *Mercy's* AMAL, or 32.4%. The FILL carries 116 of the 2997 nondrug medical consumables listed on the *Mercy's* AMAL, 3.87%. Together, the FILL carries 265 items out of the total 3457 medical consumables listed on the *Mercy* AMAL. The AFS, then, would be able to fill 7.67% of *Mercy's* 9L requirements if all of them were demanded at one time.

The point is that there is no method at present to rank the essentiality of the 9L stores carried on the AFS other than by demand. Unfortunately the demand data excludes the hospital ships. As mentioned earlier, this is not to imply there is fault with the FILL computations or the level of the AFS support. What is questioned is NAVMEDMATSUPCOM's criteria for selecting 9L cog materials authorized to be computed for an AFS load. This is the where improvements in *Mercy* support should begin.

2. AMAL Process

NAVMEDMATSUPCOM should consider some improvements to the method whereby the AMAL is derived. Inputs to SPCC's Load List Operations should be validated with the help of the afloat medical community, specifically the Fleet Medical Officers. Through this joint approach there is an improved probability that technical overrides will be applied to the medical portion of the FILL and an increased range and depth of medical consumables achieved.

However, application of the proposed essentiality index is necessary to prevent wholesale range and depth increases at the possible expense of repair parts. Medical consumables providing the highest patient cure level should be given highest priority. By validating these Group I consumables with fleet wide demands, overall effectiveness of the AFS should improve. Application of the essentiality index would necessarily have to be accomplished at NAVMEDMATSUPCOM and subsequent usage by Load List Operations would follow.

3. Essentiality Index

Overall, the application of the essentiality index to the wholesale supply system should benefit the consumer, specifically the *Mercy* in this case. By managing medical supplies with an essentiality index, attention can be focused on those critical medical consumables which contribute the most to the overall cure rate of the wounded.

As discussed in Chapter II, the CZAR/SKO outputs used in this thesis represent just one possible patient stream. By grouping the patient streams under broad climate conditions, such as arctic and temperate, further breakdown of the AFS load is possible. Items common to both climate conditions would become the basic medical portion of the FILL adjusted by essentiality index. Tailored load lists could then be computed for medical consumables peculiar to a cold or temperate climate, adjusted by the essentiality index.

D. RECOMMENDATIONS

1. The Office of the Secretary of Defense for Health Affairs should require an analysis of all service unique deployable medical systems to determine what percent of the total consumable medical items are indeed unique. Only when the amount of unique items are a significant portion of the entire Authorized Medical Allowance List, should the deployable medical system be considered as a service unique deployable

medical system. Otherwise, all deployable medical systems should come under the control of the Department of Defense.

2. Further research should be conducted into the area of normalized item essentiality index. This research could identify the index as an appropriate mechanism to allocate resources in the prepositioning of dated and deteriorated items or to identify an alternative method for achieving cost effectiveness in prepositioning medical material.

3. Further research should be conducted in the shelf life demand rotation plan. Such research should start from a simple model as identified in Chapter II and proceed to a larger model that would include Tri-Service involvement.

4. Further analysis of the application of the normalized essentiality item index to medical consumables should be undertaken by SPCC and NAVMEDMATSUPCOM to ascertain the impact on the range and depth of the forecasted FILL.

5. Fleet Medical Officers should become an active participant in the AMAL derivation and review process at NAVMEDMATSUPCOM. The input of the afloat medical community via, the Fleet Medical Officer, would ensure that afloat medical logistics problems are brought to the attention of NAVMEDMATSUPCOM which has a key input to the solution.

6. Naval Supply Systems Command should investigate tailoring a load list by climate conditions, adjusted by normalized essentiality item index. By working back up the supply pipeline, the supply points which support the AFSs can take advantage of further tailoring stocks to support the AFS.

E. CONCLUSIONS

This thesis undertook to devise a procedure whereby the medical supplies onboard the *Mercy* and its supporting AFS can be ranked by some measure of medical essentiality. Such an essentiality index can be utilized to streamline medical supplies' movement through the entire supply pipeline. Inventory management attention is focused on the Group I medical supplies identified by the essentiality index process. Further research is recommended to ascertain the level of improvement to FILL calculations and AFS support utilizing the essentiality index.

APPENDIX A

MEDICAL SURGICAL CONDITIONS

- 1) Cerebral Concussion, Closed with/without Non-Depressed Linear Skull Fracture--Severe--Loss of Consciousness from 2-12 hours
- 2) Cerebral Concussion, Closed with/without Non-Depressed Linear Skull Fracture--Moderate--Loss of Consciousness Less than 2 hours
- 3) Cerebral Contusion, Closed with/without Non-Depressed Linear Skull Fracture--Severe--Loss of Consciousness Greater than 24 hours with/without Focal Neurological Deficit
- 4) Cerebral Contusion, Closed with/without Non-Depressed Linear Skull Fracture--Moderate--Loss of Consciousness from 12-24 hours with/without Neurological Deficit
- 5) Cerebral Contusion, Closed with Intracranial Hematoma with or without Non-Depressed Linear Skull Fracture--Severe--Large Hematoma (including Epidural Hematoma) with Rapidly Deteriorating Comatose Patient
- 6) Cerebral Contusion, Closed with Intracranial Hematoma with or without Non-Depressed Linear Skull Fracture--Moderate--Small Intracerebral or Subdural Hematoma with Non-Deteriorating Comatose Patient
- 7) Cerebral Contusion, Closed with Depressed Skull Fracture--Severe--with Associated Intracerebral Hematoma and/or Massive Depression
- 8) Cerebral Contusion, Closed with Depressed Skull Fracture--Moderate--No Associated Hematoma or Significant Effect from Depression
- 9) Cerebral Contusion with Open Skull Fracture with or without Intracranial Fragments Depressed Skull Fracture--Severe--with Intracranial Fragments and/or Depressed Skull Fracture
- 10) Cerebral Contusion with Open Skull Fracture with or without Intracranial Fragments Depressed Skull Fracture--Moderate--without Intracranial Fragments and/or Depressed Skull Fracture
- 11) Intracranial Hemorrhage, Spontaneous, Non-Traumatic--Severe--Comatose or Semicomatose with Possible Respiratory Distress without Associated Hematoma
- 12) Intracranial Hemorrhage, Spontaneous, Non-Traumatic--Moderate--Awake without Respiratory Distress or Severe Neurological Deficit
- 13) Wound, Scalp, Open without Cerebral Injury or Skull Fracture--Severe--Scalped/Avulsion of Tissue
- 14) Wound, Scalp, Open without Cerebral Injury or Skull Fracture--Moderate--Scalp Laceration
- 15) Fracture, Facial Bones, Closed (exclusive of Mandible)--Severe--Multiple Fractures
- 16) Fracture, Facial Bones, Closed (exclusive of Mandible)--Moderate--Single Fracture
- 17) Wound, Face, Jaws and Neck, Open, Lacerated with Associated Fractures (excluding Spinal Fractures)--Severe--with Airway Obstruction
- 18) Wound, Face, Jaw and Neck, Open, Lacerated with Associated Fractures (excluding Spinal Fractures)--Moderate--without Airway Obstruction

- 19) Wound, Face and Neck, Open, Lacerated, Contused without Fractures--Severe--Airway Obstruction and/or Major Vessel Involvement
- 20) Wound, Face and Neck, Open, Lacerated, Contused without Fractures--Moderate--without Airway Obstruction or Major Vessel Involvement
- 21) Eye, Wound, or Injury, Closed or Open, Lacerated, Penetrating, Perforating (to include Retinal Detachment and/or Retinal Injury)--Severe--Loss of Intraocular Fluid with or without Retinal Detachment or Injury
- 22) Eye, Wound, or Injury, Closed or, Open, Lacerated, Penetrating, Perforating (to include Retinal Detachment and/or Retinal Injury)--Moderate--No Loss of Intraocular Fluid, No Retinal Lesion (to include Hyphema)
- 23) Wound, Tympanic Membrane, Perforated, Lacerated, Ruptured--Severe--Involvement of Middle Ear Ossicles
- 24) Wound, Tympanic Membrane, Perforated, Lacerated, Ruptured--Moderate--Involvement of Drum only
- 25) Fracture, Spine, Closed without Cord Damage--Severe--Unstable Lesion
- 26) Fracture, Spine, Closed without Cord Damage--Moderate--Stable Lesion
- 27) Fracture, Spine, Closed with Cord Damage--Severe--Cervical Spine with Respiratory Involvement
- 28) Fracture, Spine, Closed with Cord Damage--Moderate--Below Cervical Spine
- 29) Fracture, Spine, Open with Cord Damage--Severe--Cervical Spine with Respiratory Distress
- 30) Fracture, Spine, Open with Cord Damage--Moderate--Below Cervical Spine
- 31) Intervertebral Disc Disorders--Severe--Nerve Root Compression Resistant to Bed Rest/Traction
- 32) Intervertebral Disc Disorders--Moderate--Nerve Root Compression Responding to Bed Rest/Traction
- 33) Strains and Sprains, Sacroiliac Region--Severe--Non-Ambulatory
- 34) Strains and Sprains, Sacroiliac Region--Moderate--Ambulatory
- 35) Burn, Thermal, Superficial, Head and Neck--Severe--More than 5% Total Body Surface and/or Eye Involvement
- 36) Burn, Thermal, Superficial, Head and Neck--Moderate--Less than 5% Total Body Surface with No Eye Involvement
- 37) Burn, Thermal, Partial Thickness, Head and Neck--Severe--More than 5% Total Body Surface and/or Eye Involvement
- 38) Burn, Thermal, Partial Thickness, Head and Neck--Moderate--Less than 5% Total Body Surface with No Eye Involvement
- 39) Burn, Thermal, Full Thickness, Head and Neck--Severe--More than 5% Total Body Surface and/or Eye Involvement
- 40) Burn, Thermal, Full Thickness, Head and Neck--Moderate--Less than 5% Total Body Surface with No Eye Involvement
- 41) Fracture, Clavicle, Closed--Moderate--All Cases
- 42) Wound, Shoulder Girdle, Open with Bony Injury--Severe--Joint Involvement
- 43) Wound, Shoulder Girdle, Open with Bony Injury--Moderate--No Joint Involvement

- 44) Fracture, Humerus, Closed, Upper shaft--Moderate--All Cases
- 45) Wound, Upper Arm, Open, Penetrating, Lacerated without Fracture--Severe--with Nerve and/or Vascular Injury
- 46) Wound, Upper Arm, Open, Penetrating, Lacerated without Fracture--Moderate--without Nerve or Vascular Injury
- 47) Wound, Upper Arm, Open with Fractures and Nerve Injury--Severe--Arm Not Salvageable, Vascular Damage
- 48) Wound, Upper Arm, Open with Fractures and Nerve Injury--Moderate--Arm Salvageable, No Vascular Damage
- 49) Fracture, Radius and Ulna, Closed--Severe--Shafts of Bones
- 50) Fracture, Radius and Ulna, Closed--Moderate--Colles Fracture
- 51) Wound, Forearm, Open, Lacerated, Penetrating without Bone, Nerve or Vascular Injury--Severe--Requiring Major Debridement
- 52) Wound, Forearm, Open, Lacerated, Penetrating without Bone, Nerve or Vascular Injury--Moderate--Not Requiring Major Debridement
- 53) Wound, Forearm, Open, Lacerated, Penetrating with Fracture and with Nerve and Vascular Injury--Severe--Forearm not Salvageable
- 54) Wound, Forearm, Open, Lacerated, Penetrating with Fracture and with Nerve and Vascular Injury--Moderate--Forearm Salvageable
- 55) Fracture, Hand and/or Fingers, Closed--Severe--Requiring Closed Reduction
- 56) Fracture, Hand and/or Fingers, Closed--Moderate--Not Requiring Closed Reduction
- 57) Wound, Hand and/or Fingers, Open, Lacerated without Fractures--Severe--Tendon Involvement
- 58) Wound, Hand and/or Fingers, Open, Lacerated without Fractures--Moderate--No Tendon Involvement
- 59) Wound, Hand, Fingers, Open, Lacerated, Contused, Crushed with Fracture(s)--Severe--Involving Fractures of Carpels and/or Metacarpels
- 60) Wound, Hand, Fingers, Open, Lacerated, Contused, Crushed with Fracture(s)--Moderate--Involving Fractures of Phalangeals only
- 61) Crush Injury, Upper Extremity--Severe--Limb Not Salvageable
- 62) Crush Injury, Upper Extremity--Moderate--Limb Salvageable
- 63) Dislocation, Shoulder, Closed, Acute--Severe--Posterior Dislocation
- 64) Dislocation, Shoulder, Closed, Acute--Moderate--Anterior Dislocation
- 65) Dislocation/Fracture, Elbow, Closed, Acute--Severe--Fracture and Dislocation
- 66) Dislocation/Fracture, Elbow, Closed, Acute--Moderate--Dislocation without Fracture
- 67) Dislocation, Hand Wrist, Fingers, Closed, Acute--Severe--Wrist and Hand
- 68) Dislocation, Hand, Wrist, Fingers, Closed, Acute--Moderate--Fingers
- 69) Amputation, Hand, Traumatic, Complete--Severe--All Cases
- 70) Amputation, Forearm, Traumatic, Complete--Severe--All Cases
- 71) Amputation, Full Arm, Traumatic, Complete--Severe--All Cases

- 72) Sprain, Wrist, Closed, Acute--Moderate--All Cases
- 73) Sprain, Fingers, Thumb, Closed, Acute--Severe--Thumb Involvement
- 74) Sprain, Fingers, Thumb, Closed, Acute--Moderate--Fingers only Involved
- 75) Burn, Thermal, Superficial, Upper Extremity--Severe--Greater than 10% Total Body Area Involved
- 76) Burn, Thermal, Superficial, Upper Extremity--Moderate--Less than 10% Total Body Area Involved
- 77) Burn, Thermal, Partial Thickness, Upper Extremity--Severe--Greater than 10% Total Body Area Involved
- 78) Burn, Thermal, Partial Thickness, Upper Extremity--Moderate--Less than 10% Total Body Area Involved
- 79) Burn, Thermal, Full Thickness, Upper Extremity--Severe--Greater than 10% Total Body Area Involved
- 80) Burn, Thermal, Full Thickness, Upper Extremity--Moderate--Less than 10% Total Body Area Involved
- 81) Fracture, Rib, Closed--Severe--Multiple Fractures without Flail
- 82) Fracture, Rib, Closed--Moderate--Single Fracture
- 83) Injury, Lung, Closed (Blast, Crush) with Pneumohemothorax--Severe--One Lung with Pulmonary Contusion and Acute Severe Respiratory Distress
- 84) Injury, Lung, Closed (Blast, Crush) with Pneumohemothorax--Moderate--One Lung with Pulmonary Contusion and Respiratory Distress
- 85) Wound, Thorax (Anterior or Posterior), Open, Superficial, Lacerated, Contused, Abraded, Avulsed--Severe--Requiring Major Débridement
- 86) Wound, Thorax (Anterior or Posterior), Open, Superficial, Lacerated, Contused, Abraded, Avulsed--Moderate--Not Requiring Major Débridement
- 87) Wound, Thorax (Anterior or Posterior), Open, Penetrating with Associated Rib Fractures and Pneumohemothorax--Severe--Acute Severe Respiratory Distress
- 88) Wound, Thorax (Anterior or Posterior), Open, Penetrating with Associated Rib Fractures and Pneumohemothorax--Moderate--Respiratory Distress
- 89) Wound, Heart, Open, Penetrating, Perforating, Lacerating--Severe--All Cases
- 90) Burn, Thermal, Superficial, Trunk--Severe--Greater than 20% Total Body Area Involved
- 91) Burn, Thermal, Superficial, Trunk--Moderate--Less than 20% Total Body Area Involved
- 92) Burn, Thermal, Partial Thickness, Trunk--Severe--Greater than 20% Total Body Area Involved
- 93) Burn, Thermal, Partial Thickness, Trunk--Moderate--Less than 20% Total Body Area Involved
- 94) Burn, Thermal, Full Thickness, Trunk--Severe--Greater than 20% Total Body Area Involved
- 95) Burn, Thermal, Full Thickness, Trunk--Moderate--Less than 20% Total Body Area Involved

- 96) Wound, Abdominal Wall (Anterior or Posterior) Lacerating, Abraded, Contused, Avulsed without Entering Abdominal Cavity--Severe--Requiring Major Debridement
- 97) Wound, Abdominal Wall (Anterior or Posterior) Lacerating, Abraded, Contused, Avulsed without Entering Abdominal Cavity--Moderate--Not Requiring Major Debridement
- 98) Wound, Liver, Closed, Acute (Crush, Fracture, Rupture)--Severe--Major Liver Damage
- 99) Wound, Liver, Closed, Acute (Crush, Fracture, Rupture)--Moderate--Minor Liver Damage
- 100) Wound, Spleen, Closed, Acute (Crush, Fracture, Rupture)--Severe--All Cases
- 101) Wound, Abdominal Cavity, Open with Lacerating, Penetrating, Perforating Wound Gastrointestinal Tract--Severe--Large Bowel Wound
- 102) Wound, Abdominal Cavity, Open with Lacerating, Penetrating, Perforating Wound Gastrointestinal Tract--Moderate--Small Bowel Wounds without Major or Multiple Resections
- 103) Wound, Abdominal Cavity, Open with Penetrating, Perforating Wound, Liver--Severe--Perforated Liver, Major Damage
- 104) Wound, Abdominal Cavity, Open with Penetrating, Perforating Wound, Liver--Moderate--Lacerated Liver
- 105) Wound, Abdominal Cavity, Open with Penetrating, Perforating Wound, Spleen--Severe--All Cases
- 106) Wound, Abdominal Cavity, Open with Lacerated, Penetrating, Perforating Wound Kidney--Severe--Shattered Kidney
- 107) Wound, Abdominal Cavity, Open with Lacerated, Penetrating, Perforating Wound Kidney--Moderate--Lacerated Kidney
- 108) Wound, Abdominal Cavity, Open with Lacerated, Penetrating, Perforating Wound Bladder--Severe--Shattered Bladder
- 109) Wound, Abdominal Cavity, Open with Lacerated, Penetrating, Perforating Wound Bladder--Moderate--Lacerated Bladder
- 110) Wound, Buttocks, Open, Lacerated, Penetrating, Perforating, Contused, Abraded, Avulsed--Severe--Penetrated, Perforated, Avulsed
- 111) Wound, Buttocks, Open, Lacerated, Penetrating, Perforating, Contused, Abraded, Avulsed--Moderate--Lacerated, Contused, Abraded
- 112) Fracture, Pelvis, Closed with Associated Soft Tissue Damage--Severe--Displaced Fracture with Organ Damage
- 113) Fracture, Pelvis, Closed with Associated Soft Tissue Damage--Moderate--Undisplaced Fracture
- 114) Wound, Abdominal, Open with Fracture and Penetrating, Perforating Wounds to Pelvic Structures (Male or Female)--Severe--Involvement of Multiple Pelvic Structures
- 115) Wound, Abdominal, Open with Fracture and Penetrating, Perforating Wounds to Pelvic Structures (Male or Female)--Moderate--Involvement of Pelvic Colon Only
- 116) Wound, External Genitalia Male, Lacerated, Contused, Abraded, Avulsed, Crushed--Severe--Laceration, Crush, Avulsion

- 117) Wound, External Genitalia Male, Lacerated, Contused, Abraded, Avulsed, Crushed--Moderate--Abrasion, Contusion
- 118) Wound, External Genitalia Female, Lacerated, Contused, Abraded, Avulsed, Crushed--Severe--Laceration, Crush, Avulsion
- 119) Wound, External Genitalia Female, Lacerated, Contused, Abraded, Avulsed, Crushed--Moderate--Abrasion, Contusion
- 120) Fracture, Femur, Closed, Shaft--Severe--All Cases
- 121) Wound, Thigh, Open without Fracture, Nerve or Vascular Injury--Severe--Requiring Major Debridement
- 122) Wound, Thigh, Open without Fracture, Nerve or Vascular Injury--Moderate--Not Requiring Major Debridement
- 123) Wound, Thigh, Open, Lacerated, Penetrating, Perforating with Fracture and Nerve/Vascular Damage--Severe--Limb Not Salvageable
- 124) Wound, Thigh, Open, Lacerated, Penetrating, Perforating with Fracture and Nerve/Vascular Damage--Moderate--Limb Salvageable
- 125) Wound, Knee, Open, Lacerated, Penetrating, Perforating with Joint Space Penetration--Severe--Shattered Knee
- 126) Wound, Knee, Open, Lacerated, Penetrating, Perforating with Joint Space Penetration--Moderate--No Bony Injury
- 127) Fracture, Tibia and Fibula, Shaft, Closed--Severe--All Cases
- 128) Wound, Lower, Leg, Open, Lacerated, Penetrating, Perforating without Fractures--Severe--Requiring Major Debridement
- 129) Wound, Lower Leg, Open, Lacerated, Penetrating, Perforating without Fractures--Moderate--Not Requiring Major Debridement
- 130) Wound, Lower Leg, Open, Lacerated, Penetrating, Perforating with Fracture and Nerve/Vascular Damage--Severe--Limb Not Salvageable
- 131) Wound, Lower Leg, Open, Lacerated, Penetrating, Perforating with Fracture and Nerve/Vascular Damage--Moderate--Limb Salvageable
- 132) Fracture, Ankle/Foot, Closed--Severe--Displaced Requiring Reduction
- 133) Fracture, Ankle/Foot, Closed--Moderate--Non-Displaced Not Requiring Reduction
- 134) Wound, Ankle, Foot, Toes, Open, Lacerated, Contused without Fractures--Severe--Requiring Major Debridement
- 135) Wound, Ankle, Foot, Toes, Open, Lacerated, Contused without Fractures--Moderate--Not Requiring Major Debridement
- 136) Wound, Ankle, Foot, Toes, Open, Penetrating, Perforating with Fractures and Nerve/Vascular Damage--Severe--Limb Not Salvageable
- 137) Wound, Ankle, Foot, Toes, Open, Penetrating, Perforating with Fractures and Nerve/Vascular Injury--Moderate--Limb Salvageable
- 138) Crush Injury, Lower Extremity--Severe--Limb Not Salvageable
- 139) Crush Injury, Lower Extremity--Moderate--Limb Salvageable
- 140) Dislocation, Hip, Closed, Acute--Severe--All Cases
- 141) Tear, Ligaments, Knee, Acute--Severe--Complete Rupture
- 142) Tear, Ligaments, Knee, Acute--Moderate--Incomplete Rupture

- 143) Dislocation, Toes, Closed, Acute--Moderate--All Cases
- 144) Amputation, Foot, Traumatic, Complete--Severe--All Cases
- 145) Amputation, Lower Leg, Traumatic Complete--Severe--All Cases
- 146) Amputation, Above Knee, Traumatic Complete--Severe--Requiring Hip Disarticulation
- 147) Amputation, Above Knee, Traumatic Complete--Moderate--Requiring Above Knee Amputation
- 148) Sprain, Ankle, Closed, Acute--Severe--Complete Ligament Rupture
- 149) Sprain, Ankle, Closed, Acute--Moderate--Incomplete Ligament Rupture
- 150) Burn, Thermal, Superficial, Lower Extremity and Genitalia--Severe--Greater than 30% Total Body Area Involved
- 151) Burn, Thermal, Superficial, Lower Extremity and Genitalia--Moderate--Less than 30% Total Body Area Involved
- 152) Burn, Thermal, Partial Thickness, Lower Extremity and Genitalia--Severe--Greater than 30% Total Body Area Involved
- 153) Burn, Thermal, Partial Thickness, Lower Extremity and Genitalia--Moderate--Less than 30% Total Body Area Involved
- 154) Burn, Thermal, Full Thickness, Lower Extremity and Genitalia--Severe--Greater than 30% Total Body Area Involved
- 155) Burn, Thermal, Full Thickness, Lower Extremity and Genitalia--Moderate--Less than 30% Total Body Area Involved
- 156) Blisters, Hand, Fingers, Foot, Toes Due to Friction, Acute--Moderate--All Cases
- 157) Bites and Stings (Unspecified Body Area)--Severe--Systematic Symptoms with or without Respiratory Difficulty
- 158) Bites and Stings (Unspecified Body Area)--Moderate--Localized Symptoms
- 159) MFW, Brain and Chest with Sucking Chest Wound and Pneumohemothorax
- 160) MFW, Brain and Abdomen with Penetrating, Perforating Wound, Colon
- 161) MFW, Brain and Abdomen with Penetrating, Perforating Wound, Kidney
- 162) MFW, Brain and Abdomen with Penetrating, Perforating Wound, Bladder
- 163) MFW, Brain and Abdomen with Shock and Penetrating, Perforating Wound, Spleen
- 164) MFW, Brain and Abdomen with Shock and Penetrating, Perforating Wound, Liver
- 165) MFW, Brain and Lower Limbs Requiring Bilateral Above Knee Amputations
- 166) MFW, Chest (with Simple Pneumohemothorax) and Abdomen (with Penetrating Wound Colon)
- 167) MFW, Chest (with Pneumohemothorax) and Abdomen (with Penetrating, Perforating Wound, Kidney)
- 168) MFW, Chest (with Pneumohemothorax) and Abdomen (with Perforating Wound, Bladder)

- 169) MFW, Chest (with pneumohemothorax) and Abdomen (with Penetrating, Perforating Wound, Spleen)
- 170) MFW, Chest (with Pneumohemothorax) and Abdomen (with Penetrating, Perforating Wound, Liver)
- 171) MFW, Chest (with Pneumohemothorax) and Limbs (with Fracture and Vascular Injury)
- 172) MFW, Abdomen with Penetrating, Perforating Wound of Colon and Bladder
- 173) MFW, Abdomen with Penetrating, Perforating Wound of Colon and Spleen
- 174) MFW, Abdomen with Penetrating, Perforating Wound of Colon and Liver
- 175) MFW, Abdomen with Limbs with Penetrating, Perforating Wound of Colon and Open Fracture, and Neurovascular Wound of Salvageable Lower Limb
- 176) MFW, Abdomen and Pelvis with Penetrating, Perforating Wound of Liver and Kidney
- 177) MFW, Abdomen and Pelvis with Penetrating, Perforating Wounds of Spleen and Bladder
- 178) MFW, Abdomen, Pelvis, Limbs with Fracture and Neurovascular Damage (Salvageable) and Penetrating Wound, Kidney
- 179) MFW, Abdomen, Pelvis, Limbs without Fracture or Neurovascular Injury (Limbs) and with Penetrating, Perforating Wound, Bladder
- 180) MFW, Abdomen and Limbs with Fracture and Nerve Injury of Limb and with Spleen Damage.
- 181) MFW, Abdomen and Limbs without Fracture or Nerve Injury to Limbs with Liver Damage
- 182) MFW, Chest, Upper Limbs and Brain with Pneumohemothorax, Soft Tissue Injury to Limbs and Penetrating Fragments with Brain Damage
- 183) MFW, Chest, Upper Limbs and Abdomen with Simple Pneumohemothorax, Soft Tissue Injury to Limbs and Wound of Colon
- 184) MFW, Abdomen, Chest and Pelvis with Pneumohemothorax, Wound of Colon and Wound of Bladder
- 185) MFW, Abdomen and Chest with Multiple Organ Damage
- 186) Multiple Non-Perforating Fragment Wounds of Skin and Soft Tissue
- 187) Trenchfoot, Immersion Foot--Severe--Vesicle Formation
- 188) Trenchfoot, Immersion Foot--Moderate--No Vesicle Formation
- 189) Chilblains--Moderate--All Cases
- 190) Frostbite, Superficial or Deep--Severe--Full Skin Thickness or More Involved (Third or Fourth Degree)
- 191) Frostbite, Superficial or Deep--Moderate--Less than Full Skin Thickness Involved (First and Second Degree)
- 192) Hypothermia--Severe--All Cases
- 193) Heat Stroke/Heat Exhaustion--Severe--Heat Stroke
- 194) Heat Stroke/Heat Exhaustion--Moderate--Heat Exhaustion
- 195) Heat Cramps--Moderate--All Cases

- 196) Appendicitis, Acute--Severe, with Perforation, Rupture, Peritonitis
- 197) Appendicitis, Acute--Moderate--without Perforation, Rupture, Peritonitis
- 198) Inguinal Hernia, Uncomplicated--Severe--Direct Inguinal Hernia
- 199) Inguinal Hernia, Uncomplicated--Moderate--Indirect Inguinal Hernia
- 200) Internal Derangement of Knee, Chronic with Torn Meniscus and/or Ligament Lascity--Moderate--All Cases
- 201) Strain, Lumbosacral, Sacroiliac Joint, Chronic--Moderate--All Cases
- 202) Eczema, Dermatitis (Seborrheic, Contact, Others)--Severe--Affecting Weight Bearing or Pressure Areas
- 203) Eczema, Dermatitis (Seborrheic, Contact, Others)--Moderate--Not effecting Areas of Weight Bearing
- 204) Boils, Furuncles, Pyoderma--Severe--Requiring Surgical Intervention
- 205) Boils, Furuncles, Pyoderma--Moderate--Not Requiring Surgery
- 206) Cellulitis--Severe--Involving Face or Weight Bearing Areas
- 207) Cellulitis--Moderate--Involving Other Areas
- 208) Dermatophytosis--Severe--Chronic and/or Affecting Feet
- 209) Dermatophytosis--Moderate--Acute, Feet not Involved
- 210) Pediculosis--Moderate--All Cases
- 211) Scabies--Moderate--All Cases
- 212) Pilonidal Cyst/Abscess--Severe--Requiring Major Excision
- 213) Pilonidal Cyst/Abscess--Moderate--Requiring Minor Incision
- 214) Ingrown Toenails--Severe--Bilateral
- 215) Ingrown Toenails--Moderate--Unilateral
- 216) Herpes Simplex (Excluding Complicating Encephalitis)--Moderate--All Cases
- 217) Herpes Zoster--Severe--Prolonged Pain, Ophthalmic Involvement
- 218) Herpes Zoster--Moderate--Uncomplicated Disease
- 219) Hyperhydrosis--Moderate--All Cases
- 220) Blepharitis--Moderate--All Cases
- 221) Conjunctivitis, Acute or Chronic--Severe--Bilateral, Acute
- 222) Conjunctivitis, Acute or Chronic--Moderate--Unilateral, Chronic or Acute
- 223) Corneal Ulcer, Abrasion--Severe--Corneal Ulcer
- 224) Corneal Ulcer, Abrasion--Moderate--Corneal Abrasion
- 225) Iridocyclitis, Acute--Severe--Marked Visual Impairment
- 226) Iridocyclitis, Acute--Moderate--Less Marked Visual Impairment
- 227) Refracton and Accommodation Disorders--Severe--Refraction Required

- 228) Refraction and Accommodation Disorders--Moderate--Replacement of Spectacles Only, Required
- 229) Otitis Externa--Moderate--All Cases
- 230) Otitis Media, Acute, Suppurative--Moderate--All Cases
- 231) Mastoiditis, Chronic--Moderate--All Cases
- 232) Allergic Rhinitis (Hay Fever)--Moderate--All Cases
- 233) Upper Respiratory Infection (Acute, Multiple Sites, Including Streptococcal Infection)--Moderate--All Cases
- 234) Bronchitis, Acute--Moderate--All Cases
- 235) Asthma--Severe--Disabling Symptoms or Repeat Attacks
- 236) Asthma--Moderate--Moderate Symptoms
- 237) Influenza, All Manifestations Including Pneumonia--Severe--Disabling with or without Pneumonia
- 238) Influenza, All Manifestations Including Pneumonia--Moderate--Less Severe without Pneumonia
- 239) Viral Pneumonia--Severe--Involving more than One Lobe, Complicated
- 240) Viral Pneumonia--Moderate--Less Severe Cases
- 241) Pneumonia, Bacterial (Pneumococcal, Streptococcal, Staphylococcal)--Severe--Involving More than One Lobe, Complicated
- 242) Pneumonia, Bacterial (Pneumococcal, Streptococcal, Staphylococcal)--Moderate--Less Severe Cases
- 243) Food Poisoning, Staphylococcal--Severe--Disabling Symptoms
- 244) Food Poisoning, Staphylococcal--Moderate--Less Disabling Symptoms
- 245) Shigellosis (Bacillary Dysentery)--Moderate--All Cases
- 246) Enteritis, Diarrheal Disease, E Coli, etc.--Moderate--All Cases
- 247) Amebic Dysentery, Acute, No Abscesses--Moderate--All Cases
- 248) Gastritis, Acute--Moderate--All Cases
- 249) Peptic Ulcer, Gastric, Duodenal--Severe--Penetrating, Perforating
- 250) Peptic Ulcer, Gastric, Duodenal--Moderate--Uncomplicated
- 251) Regional Ileitis--Severe--Disabling Symptoms
- 252) Regional Ileitis--Moderate--Less Disabling Symptoms
- 253) Helminthiasis--Severe--Trichinosis, Filariasis, Schistosomiasis
- 254) Helminthiasis--Moderate--Others
- 255) Migraine, Acute, Recurrent--Moderate--All Cases
- 256) Varicosities, Anal, Vulval, Saphenous--Severe--Hemorrhoidal Disease
- 257) Varicosities, Anal, Vulval, Saphenous--Moderate--Saphenous Varicosities
- 258) Essential Hypertension--Moderate--All Cases
- 259) Ischemic, Other Heart Disease--Severe--All Cases

- 260) Phlebitis--Severe--Deep Vein Involvement
- 261) Phlebitis--Moderate--Superficial Vein Involvement
- 262) Tenosynovitis, Elbow, Wrist, Shoulders, Etc.--Moderate--All Cases
- 263) Meningococcal Meningitis--Severe--Complicated (Deafness, Blindness, Psychosis)
- 264) Meningococcal Meningitis--Moderate--Uncomplicated
- 265) Meningitis, Aseptic (Viral)--Moderate--All Cases
- 266) Fever of Unknown Origin--Moderate--All Cases
- 267) Syphilis, Genital (Primary)--Moderate--All Cases
- 268) Gonorrhoea, Acute, Lower Genito-Urinary Tract--Moderate--All Cases
- 269) Non-Specific Urethritis--Moderate--All Cases
- 270) Chancroid--Moderate--All Cases
- 271) Lymphogranuloma Venereum/Granuloma Inguinale--Moderate--All cases
- 272) Glomerulonephritis, Acute--Moderate--All Cases
- 273) Glomerulonephritis, Chronic--Moderate--All Cases
- 274) Pyelonephritis, Acute--Severe--Secondary to Obstruction
- 275) Pyelonephritis, Acute--Moderate--No Obstruction
- 276) Nephrotic Syndrome--Moderate--All Cases
- 277) Ureteric Calculus--Severe--Causing Obstruction, Impacted
- 278) Ureteric Calculus--Moderate--Not Causing Obstruction
- 279) Cystitis, Prostatitis, Acute--Moderate--All Cases
- 280) Balanoposthitis--Moderate--All Cases
- 281) Mumps--Moderate--All Cases
- 282) Mononucleosis, Infectious (Viral)--Moderate--All Cases
- 283) Hepatitis, Infectious (Viral)--Moderate--All Cases
- 284) Cholecystitis, Acute with Stones--Severe--Complicated (Empyema, Perforation)
- 285) Cholecystitis, Acute with Stones--Moderate--Not Complicated
- 286) Pancreatitis, Acute--Severe--All Cases
- 287) Cirrhosis--Severe--Hemorrhagic Complications
- 288) Cirrhosis--Moderate--No Hemorrhage
- 289) Neoplasms, Benign or Malignant--Severe--Malignant
- 290) Neoplasms, Benign or Malignant--Moderate--Benign
- 291) Disorders of Menstruation: to Include Dysmenorrhoea, Amenorrhoea
Dysfunctional Uterine Bleeding--Severe--Dysfunctional Uterine Bleeding

- 292) Disorders of Menstruation: to Include Dysmenorrhoea, Amenorrhoea
Dysfunctional Uterine Bleeding--Moderate--Dysmenorrhoea, Amenorrhoea
- 293) Salpingo-oophoritis, Acute (Pelvic Inflammatory Disease)--Moderate--All
Cases
- 294) Cervicitis, Endocervicitis with Symptomatic Leukorrhea--Moderate--All Cases
- 295) Vulvovaginitis--Moderate--All Cases
- 296) Abortion, Legally Induced--Moderate--All Cases
- 297) Tubal Pregnancy--Severe--Impending Rupture, Rupture
- 298) Tubal Pregnancy--Moderate--Not Ruptured
- 299) Abortion, Spontaneous with Hemorrhage--Moderate--All Cases
- 300) Pregnancy, Uncomplicated--Moderate--All Cases
- 301) Psychoses--Severe--All Cases
- 302) Personality Disorders--Moderate--All Cases
- 303) Psychophysiologic Disorders--Moderate--All Cases
- 304) Stress Reaction, Acute--Severe--Combat Exhaustion
- 305) Stress Reaction, Acute--Moderate--Combat Reaction, Psychoneurosis
- 306) Alcohol Dependency Syndrome--Moderate--All Cases
- 307) Drunkenness, Simple, Acute--Moderate--All Cases
- 308) Drug Dependency (Other than Alcohol)--Severe--Dependence and/or
Addiction
- 309) Drug Dependency (Other than Alcohol)--Moderate--Improper Use

APPENDIX B

ITEM STRUCTURE TREE FOR SEVERE IMMERSION FOOT

National Stock Number	Nomenclature
6505-00-100-9985	Aspirin Tablets
6505-00-117-8579	Penicillin Tablets
6505-00-118-2132	Codeine Sulfate Tablets
6505-00-132-6904	Isoniazid Tablets
6505-00-165-6545	Cephalexin Capsules
6505-00-165-6575	Rifampin Capsules
6505-00-400-2054	Codeine and Acetaminophen Tablets
6505-00-655-8355	Tetracycline Capsules
6505-00-680-2433	Tetanus Toxoid Injection
6505-00-754-0374	Povidone-Iodine Solution, 1 Gal.
6505-00-783-7218	Oiazepam Tablets
6505-00-890-1840	Metronidazole Tablets
6505-00-890-1975	Globulin Tetanus Immune
6505-00-914-3593	Povidone-Iodine Solution, 1/2 fl. oz., 50's
6505-00-985-7301	Acetaminophen Tablets
6505-01-016-1470	Sulfamethoxazole and Trimethoprim Tablets
6505-01-024-8335	Dicloxacillin Sodium Capsules
6505-01-075-0678	Sodium Chloride Irrigation
6505-01-098-0247	Ibuprofen Tablets
6505-01-113-4758	Erythromycin Tablets
6505-01-132-0257	Sulfadoxine and Pyrimethamine Tablets
6510-00-018-6184	Pad, Nonadherent, 2" x 3"
6510-00-111-0708	Pad, Nonadherent, 3" x 4"
6510-00-201-4000	Cotton, Purified
6510-00-203-2270	Pad Abdominal, 12" x 16"
6510-00-582-7992	Bandage Gauze, Elastic
6510-00-775-5706	Pad Abdominal, 8" x 7-1/2"
6510-00-782-2699	Sponge Surgical Gauze, 4" x 8"
6510-00-786-3736	Pad, Isopropyl Alcohol
6510-00-926-8882	Adhesive Tape Porous Woven 1"
6510-00-926-8884	Adhesive Tape Porous Woven 3"
6510-00-935-5822	Bandage, Elastic, Rubber, 4" x 4-1/2"
6510-00-935-5832	Bandage, Elastic, Rubber, 6" x 4-1/2"
6510-01-050-8722	Bandage Gauze, Fine Mesh
6510-01-115-4729	Pad, Petrolatum and Bismuth Tribromophenate Impregnated
6510-01-120-2642	Pad, Petrolatum and Bismuth Impregnated
6515-00-226-0250	Suture, Nonabsorbable Surgical, Size: 6-0
6515-00-462-7348	Syringe, Hypodermic Disposable, 3 ML
6515-00-655-5751	Needle, Hypodermic Disposable, 25 Gauge
6515-00-754-2836	Needle, Hypodermic Disposable, 20 Gauge
6515-00-905-1473	Applicator Disposable, Cotton Tipped End
6515-00-965-2253	Suture, Nonabsorbable Surgical, Size: 4-0
6515-01-125-6585	Suture, Absorbable Surgical, Size: 4-0
6515-01-149-8840	Gloves, Sterile, Disposable, Size 7
6515-01-149-8841	Gloves, Sterile, Disposable, Size 7-1/2
6515-01-149-8842	Gloves, Sterile, Disposable, Size 8
6515-01-149-8843	Gloves, Sterile, Disposable, Size 8-1/2
6515-01-207-8217	Cover Electronic Thermometer
6530-00-104-7631	Band Personnel ID Adult Patient Plastic
6530-00-772-5935	Brush Surgical Scrub
6530-00-890-1786	Patient Utility Kit Plastic
6530-01-151-1807	Envelope Sterilization-1/4" x 10"
6530-01-166-3494	Band Personnel ID Adult Patient Red, 500's
6530-01-166-3499	Patient Utility Kit Disposable, 12's
6530-01-166-9517	Shave Kit, Patient Personnel
6530-01-169-0244	Envelope Sterilization-12" x 15"
6532-00-079-7889	Slippers, Patient, Disposable, Size 4-6
6532-00-079-7899	Slippers, Patient, Disposable, Size 6-8
6532-00-079-7902	Slippers, Patient, Disposable, Size 8-10
6532-00-079-7904	Slippers, Patient, Disposable, Size 10-12

8105-00-848-9631
8540-00-279-7777

Bag, Plastic, Height 54" x Width 36", Heat Sealed
Napkin, Paper, 8 Fold (GSA)

APPENDIX C ATLANTIC FLEET FILL

COG	ITEMS	VALUE(S)
1H	833	782,479
1I	82	24,049
1R	7	4,391
2F	2	256,000
2J	1	7,320
2Z	2	93,940
3N	1	3
7G	264	2,219,294
7H	607	3,517,293
7R	1	5,730
7Z	1	1,520
9C	2,136	763,011
9D	286	442,923
9E	1	6
9F	38	4,794
9G	1,807	902,524
9H	32	19,507
9I	9	1,009
9J	16	3,980
9K	10	559
9L	416	155,193
9N	5,055	613,526
9O	1	1,630
9Q	1,215	725,771
9V	13	499
9W	3	349
9Y	70	35,570
9Z	3,831	343,746
APA	5	357,260
NSA	16,735	10,569,995
TOTAL	16,740	10,927,255

APPENDIX D PACIFIC FLEET FILL

COG	ITEMS	VALUE(S)
1H	833	632,962
1I	82	8,776
1R	7	4,391
2F	2	256,000
2J	1	7,320
2Z	2	85,370
5N	1	4
7G	264	2,180,310
7H	607	3,458,178
7R	1	5,730
7Z	1	1,520
9C	2,136	671,740
9D	286	315,344
9E	1	7
9F	38	3,995
9G	1,807	733,497
9H	32	4,210
9I	9	941
9J	16	3,598
9K	10	330
9L	416	161,724
9N	5,055	517,338
9O	1	1,196
9Q	1,215	573,447
9V	13	492
9W	3	66
9Y	70	30,231
9Z	3,831	295,356
APA	5	348,690
NSA	16,735	9,605,383
TOTAL	16,740	9,954,073

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